SIGNAL2000
Tutorial/Reference Manual

SIGNAL2000/TEAPAC

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SIGNAL2000/TEAPAC
Signalized Intersection Analysis and Design

SIGNAL2000 is a program for performing true-HCM capacity analysis, signal timing and phasing optimization and design of intersection geometry and control for as many as 500 intersections at a time. This comprehensive program considers such broad inputs as lane group geometry, lane usage, pedestrian and clearance constraints and multi-phase signal control. The methodology uses the capacity analysis procedures documented in the 2000 *Highway Capacity Manual* from TRB, with a user-specified calibration option. The user of the program can analyze existing conditions and timings as well as generate optimum signal timings and phasings. The optimizer in the program seeks to establish the best attainable level of service, delay or v/c for critical movements within a specified range of cycle lengths using the 2000 *Highway Capacity Manual* method.

This interactive analysis tool is particularly useful in developing individual intersection control strategies, controller requirements and required timings since an entire day's variation in volumes can be analyzed quickly and accurately. Two-phase, three-phase, multi-phase, and split-phase control strategies are considered, with the best phasing being identified for each set of input data and operational constraints, such as minimum greens and clearance requirements. The user can easily scan the output and quickly determine which phasing will handle an adverse situation most efficiently.

Further, this analysis quickly identifies capacity problems and points directly to the cause of the problem. At this point, solutions can be generated to solve the problem in terms of more sophisticated control strategies, revised lane usage, improved roadway geometrics, or any combination of the above. These solutions can be tested quickly under re-optimized conditions. The results of this analysis provide the user with valuable timing data related to local control for field implementation.

As part of the integrated TEAPAC package, SIGNAL2000 does not stand by itself. It can share input and output with TURNS for peak hour count analyses, WARRANTS for signalized intersection warrant analysis, SITE to analyze projected volumes for impact analyses, PREPASSR & PRETRANSYT for signal timing with PASSER-2 and TRANSYT-7F, and PRENETSIM for simulation/animation with NETSIM/CORSIM. As such, SIGNAL2000 is the cornerstone program of TEAPAC. SIGNAL2000 is a major update of the popular SIGNAL85, SIGNAL94 and SIGNAL97 programs which implemented the methods of the original 1985 *Highway Capacity Manual*.

ACKNOWLEDGMENTS

The SIGNAL2000 program was developed by Dennis W. Strong of Strong Concepts. The method of SIGNAL2000 was transferred directly from its predecessors, SIGNAL, SIGNAL85, SIGNAL94 and SIGNAL97. SIGNAL was originally written by the same author in 1974 to use the 1965 *Highway Capacity Manual* methods. It was subsequently modified to create SIGNAL85 which implemented the 1985 *Highway Capacity Manual* methods, then to create SIGNAL94 and SIGNAL97 which implemented the 1994 and 1997 *Highway Capacity Manual* method updates. SIGNAL2000 is presently supported by and undergoing continued development and enhancement by Dennis W. Strong of Strong Concepts.

The original *SIGNAL Tutorial/Reference Manual* was written by Dennis W. Strong and M. Janet Reid. It was subsequently modified by Dennis W. Strong, Robert H. Eckols, and Barry A. Rosenberg. The current version of the *SIGNAL2000 Tutorial/Reference Manual* was developed by and is presently being enhanced and maintained by Dennis W. Strong of Strong Concepts.

This document, the *SIGNAL2000 Tutorial/Reference Manual*, is provided as a part of the license to use SIGNAL2000/TEAPAC. References in this document are made to other documents which are not included with the SIGNAL2000 program and are available from various sources. In particular, references are made to the *TEAPAC Tutorial/Reference Manual* which is available from Strong Concepts. This document applies generically to all TEAPAC programs and describes the details of and advanced usage procedures for the common interface used by all TEAPAC programs.

Comments on the usefulness and organization of the program and this document are welcome, as continual updates and improvements are being made. Please direct your comments to Strong Concepts.

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CONTENTS

Tutorial Manual

Reference Manual

Index

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

Introduction

Chapter 1 Topics

Strong Concepts develops and maintains a package of programs which provides quick, accurate and consistent analysis and design of traffic and transportation-related engineering problems. These programs are known collectively as TEAPAC, an acronym for Traffic Engineering Application PACkage. More than a dozen integrated programs are included in TEAPAC, all of which use the same basic user interface and procedures to direct the actions of the programs. In addition, these programs share the same characteristics with regard to data entry conventions and storage format for data files. This allows convenient and efficient sharing of information between programs.

SIGNAL2000 is one of the programs within the TEAPAC program package. SIGNAL2000 is designed to aid in the analysis and optimized design of individual intersection control based on factors such as approach geometry, lane usage, phasing and pedestrian constraints. The methodology uses the capacity analysis procedures documented in the Transportation Research Board 2000 *Highway Capacity Manual*. The program can be used to analyze existing conditions or to design for future conditions.

In order to illustrate these features, an initial example for the SIGNAL2000 program has been created. By following the step-by-step instructions contained in Chapter 2 of this manual, you will become familiar with the basic SIGNAL2000 commands and procedures. If unfamiliar with the TEAPAC package in general, review of the tutorial section (Chapters 1-4) of the *TEAPAC Tutorial/Reference Manual* will increase the speed and effectiveness of learning the SIGNAL2000 program.

Chapter 1 Topics:

Structure and Organization

This document, the *SIGNAL2000 Tutorial/Reference Manual*, explains the data entries and procedures necessary to use the SIGNAL2000 program. The organization of the *SIGNAL2000 Tutorial/Reference Manual* is similar to all of the TEAPAC manuals. Chapters 1 through 5 serve as the program Tutorial Manual. The tutorial steps through a simple example problem and then discusses the specific analysis techniques and procedures of the SIGNAL2000 program. The attached appendices form the program Reference Manual which provides easy look-up of detail on the program's inputs, operation and output. The following paragraphs briefly describe each section of this manual.

This chapter, Chapter 1, discusses the overall structure of the tutorial/reference manual and the conventions used throughout (see the outline in Table 1-1). It also contains a brief explanation of the basic procedures of TEAPAC which are described in detail in the *TEAPAC Tutorial/Reference Manual*. If you are unfamiliar with the TEAPAC package, you could review the tutorial section of the *TEAPAC Tutorial/Reference Manual* in order to better understand the basic TEAPAC inputs and procedures.

Table 1-1
Organization of the SIGNAL2000 Tutorial

In order to illustrate the features and basic procedures of SIGNAL2000, Chapter 2 presents a "hands-on" example problem with detailed step-by-step instructions on how to execute a simple analysis using the SIGNAL2000 program. This chapter provides an opportunity to use the SIGNAL2000 program and observe the results.

Chapter 3 discusses the analysis techniques and procedures which should be used with the SIGNAL2000 program, as illustrated by the example presented in the previous chapter. After reading this section, it should be possible to perform simple analyses using the SIGNAL2000 program.

Chapter 4 provides a summary of each of the action and entry dialogs used by the SIGNAL2000 program, organized by function (details are in Appendix B). This includes a summary of the basic TEAPAC actions and entries which appear in all TEAPAC programs. More detail on these TEAPAC functions can be found in Appendix B and the *TEAPAC Tutorial/Reference Manual*.

Chapter 5 discusses advanced techniques for using the SIGNAL2000 program which will improve the efficiency of conducting analyses. These techniques require a working familiarity with the basic principles of using both the TEAPAC package and the SIGNAL2000 program, as described in Chapters 1-4.

Attached to this tutorial are eight appendices (A through H) which form the SIGNAL2000 Reference Manual. Each of these appendices is designed to provide quick answers to questions which may arise during the use of SIGNAL2000. These appendices provide detail on program actions, entries, methods and formulae used in calculating results, program reports, error messages, operating system conventions and addenda. Their contents are each ordered in a manner that is convenient for lookup purposes. The introduction at the front of the appendices briefly describes each appendix and how to use it as a reference document. An index at the end of the entire document is provided for the combined Tutorial/Reference Manual.

Conventions

Due to the interactive nature of the SIGNAL2000 program, the tutorial contains sections which provide "hands-on" program instructions. When reading these sections, it is recommended that each step be executed as shown in the documentation. The information described below will help in understanding the conventions and terms used in this example, as well as the entire document.

Definition of Terms

Important terms which are used throughout the documentation are defined in Table 1-2. It is helpful to be familiar with these terms prior to using the tutorial/reference manual.

Table 1-2
Definition of Terms

Program Control Menu. SIGNAL2000 starts up in the Normal View of the Visual Mode by first displaying the Main Menu. From this menu, all program options can be selected and executed, including the Tabular View and the Manual Mode.

Menu Line Item. A Menu Line Item is one of the options displayed in any drop-down menu, or in a lower-level menu. It can be selected and executed to display a dialog box to enter data or execute a function.

Dialog Box. When a Menu Line Item is selected or the ASK command is used, a dialog box is displayed. In this display, data entries can be easily entered and changed, and calculations can be initiated, by simple cursor and/or mouse movements.

Command. A Command is the keyword used to identify a dialog box, and is the first word of an Input Line which identifies the kind of action to be performed by the program. These actions are either to enter data or to perform analyses.

Parameter Values. Parameter Values are data entries found in a dialog box, or which follow a Command on an Input Line. These values define the data being entered or control the analysis to be performed. Most dialog boxes have at least one Parameter Value associated with it.

Default Value. When the program is run initially, all parameter values take on pre-assigned default values. These are reasonably typical values. Default Values can be restored using the File-New menu or the RESET command.

Command Level Prompt. The Command Level Prompt, "→", is displayed in the Manual Mode when ready to accept a Command Input Line from the keyboard.

Input Line. An Input Line consists of a Command keyword and its Parameter Values. An Input Line may be entered in either the Tabular View or Manual Mode, or LOADed from a data file.

Group Name. Groups Names are used to identify sets of commands which share a common function. These commands can be referenced together as a group by using the Group Name enclosed in square brackets, e.g. [BASIC].

File. A file is a place on a permanent storage disk where program entry information is stored. This information can be either input data information (a data file), commands to direct computations (a control file), or a combination of both.

Intersection Approach and Movement Data Entry

TEAPAC programs enter intersection approach and movement data in a standard order, starting from the north and moving clockwise around the intersection. These conventions should be understood when entering intersection data, as described below and as illustrated in Figure 1-1.

Approach Data - When approach information is required and four parameter values are to be entered, one for each approach, data will be entered starting with the north approach followed by the east, south and west approaches (approach numbers 1, 2, 3, and 4). When data is required for a specific approach, the approach should be specified using the cardinal direction codes North, East, South, and West, meaning from the North, from the East, etc.

Turning Movement Data - When movement information is required and twelve parameter values are to be entered, one for each movement, data will be entered starting with the right-turn movement on the north approach followed by the through movement and left-turn movements on the north approach, then continuing with the right, through, and left on the east, south, and west approaches (movement numbers 1, 2, 3, up to movement 12). When data is required for a specific movement, the movement should be specified using numbers 1 through 12.

```
                                                               ^
                                                               |
                                                               |
                |                          |                   |
                |        Approach 1        |                 North
                |        from North        |                   |
                |                          |               W --+-- E
                |    1   2   3             |                   |
                |    |   |   |             |                   S
                |    |   |   |             |
                |    |   |   |             |
________________| <--    |  -->            |______________
                         v
                                           ^
                                           |______ 4

                                          <------- 5     Approach 2
                                            ______       from East
                                           |       6
                                           v
                         ^
              12 ________|

Approach 4    11  ------->
from West        ________
              10         |
                         v
                                    ^
________________                            ______________
                |           <--     |  -->  |
                |               |   |   |   |
                |               |   |   |   |
                |               |   |   |   |
                |               9   8   7   |
                |                           |
                |                           |
                |        Approach 3         |
                |        from South         |
```

Intersection approach and turning movement data should be entered in the order shown in this figure.

Figure 1-1
Intersection Approach and Turning Movement Conventions

Phasing Sequence Codes

All TEAPAC programs which require phasing information for an intersection use the same basic phasing codes on the SEQUENCES entry to represent complex phasing schemes with simple two-digit codes. The first digit represents the type of phasing for the north/south movements, while the second digit represents the type of phasing for the east/west movements. The phase codes allowed for north/south and east/west are identical, the east/west codes simply being the north/south code rotated clockwise 90 degrees. This basic phasing code can be augmented by entries to change the order of the basic sequence code (LEADLAGS), by adding permitted left turns before or after exclusive left turn phases (PERMISSIVES), and by adding right turns which overlap into the other direction's phases (OVERLAPS). Figure 1-2 illustrates each of the eight

basic phase types, with an example of how they are combined to create a SEQUENCE phase code.

Sequence 1

```
-------------
| * * *     |       ^
| * * *     |       |
|<* * *>    |       |
|   v   ^   |     North
|    <* * *>|       |
|     * * * |
|     * * * |
-------------
```

Sequence 4 - Dual Lead

```
-------------------------
|     * ^   | * * +     |
|     * ++++| * * +     |
|     *>    |<* * +>    |
|           |   v   ^   |
|    <*     |    <+ * *>|
|++++ *     |     + * * |
|   v *     |     + * * |
-------------------------
```

Sequence 2 - North Lead

```
-------------------------
| * * * ^   | * * +     |
| * * * ++++| * * +     |
|<* * *>    |<* * +>    |
|   v       |   v   ^   |
|           |    <* * *>|
|           |     * * * |
|           |     * * * |
-------------------------
```

Sequence 5 - Dual Lead, North Overlap

```
-------------------------------------
|     * ^   | * * * ^   | * * +     |
|     * ++++| * * * ++++| * * +     |
|     *>    |<* * *>    |<* * +>    |
|           |   v       |   v   ^   |
|    <*     |           |    <+ * *>|
|++++ *     |           |     + * * |
|   v *     |           |     + * * |
-------------------------------------
```

Sequence 3 - South Lead

```
-------------------------
|           | * * *     |
|           | * * *     |
|           |<* * *>    |
|       ^   |   v   ^   |
|    <* * *>|    <+ * *>|
|++++ * * * |     + * * |
|   v * * * |     + * * |
-------------------------
```

Sequence 6 - Dual Lead, South Overlap

```
-------------------------------------
|     * ^   |           | * * +     |
|     * ++++|           | * * +     |
|     *>    |           |<* * +>    |
|           |       ^   |   v   ^   |
|    <*     |    <* * *>|    <+ * *>|
|++++ *     |++++ * * * |     + * * |
|   v *     |   v * * * |     + * * |
-------------------------------------
```

Sequence 7 - Split Phase

```
-------------------------
| * * * ^   |           |
| * * * ++++|           |
|<* * *>    |           |
|   v       |       ^   |
|           |    <* * *>|
|           |++++ * * * |
|           |   v * * * |
-------------------------
```

Sequence 8 - Lead/Lag

```
-------------------------------------
| * * * ^   | * *       |           |
| * * * ++++| * *       |           |
|<* * *>    |<* *       |           |
|   v       |   v   ^   |       ^   |
|           |    <+ * *>|    <* * *>|
|           |     + * * |++++ * * * |
|           |     + * * |   v * * * |
-------------------------------------
```

Rotate diagrams clockwise 90 degrees for phase types of East/West movements. Use PERMISSIVES to allow left turns shown with "+" symbols. Use OVERLAPS to allow right turns shown with "+" symbols where exclusive right turn lanes exist. Use LEADLAGS to reverse the order of a phase type. Phase types are combined for both directions to create a sequence code. E.g., SEQUENCE 53 is a Dual Lead, North Overlap (5) for the North/South movements followed by a West Lead (3) for the East/West movements.

Figure 1-2
Phasing Codes for TEAPAC

Version Number

The version number (x.yz) and date describe what revision of the program is being used. Minor revisions of the program increment the z-part of the version number, with more significant changes affecting the y-part of the version number. The version number itself (x) changes when major program changes are made. The date reflects when the given version of the program was introduced. The version number and date of the program is displayed using the Help-About menu. It is also displayed in each printed report title. This information should match the title page of any printed program documentation or the Help-Version menu of the on-screen documentation. If this is not the case, check by using the Help-RecentChanges menu for addenda which explain changes which have been implemented since your documentation was prepared. These addenda should be printed and inserted in Appendix H in the back of the manual for future off-line reference. The version number of the TEAPAC Interface used in the program is also displayed with the Help-About menu.

Input Modes

The Main Menu of the Visual Mode is the first display. This is where all program actions can be initiated, including data entry and computations. Each line of a menu uses a command keyword to describe what that menu line selection will allow the user to accomplish. For sub-menus, a ‘group name’ is used to label the primary menu line.

Menu selections can be made with the mouse, or with the underlined Alt keys (and the Enter key, if required). When this is done, a dialog box is displayed which allows entry or editing of current data values, or execution of action dialogs with the Execute button. Dialog boxes can be terminated with the OK button, the Close button, or the ESCape key.

The Main Menu can be used to select the Tabular View as an alternate input environment using the View menu. In Tabular View displays, each line of the display is preceded by a command keyword which describes the contents of the command line. The bottom line of the dialog provides HELP on how to use this command. If this command is an action command it requires use of the Execute button to perform the action. The Help (?) button can be used to access context-sensitive on-screen help. The Tabular View can also be toggled using the F3 key.

The Main Menu can also be used to select the Manual Mode as another alternate input environment using the Options menu. This mode allows quick entry of the same command lines of the Tabular View, but without the rigid structure of the Tabular View dialog box. The Manual Mode is indicated by the presence of the command prompt in the Manual Mode window, as shown below:

→

When a command prompt is displayed, the program is ready to accept command keyword input. Input is the same as a line of the Tabular View display, but must be preceded by the command

(or abbreviation) which is to be used for the input. The Manual Mode can also be toggled using the F4 function key.

Example Data Entries

When executing the "hands-on" examples in this manual, actual entries to be made by the user are shown here in **BOLDFACE CAPITAL LETTERS**. The information which precedes these values indicates what command keyword should be used, showing both the menu line group name and the command name. In the Visual Mode, the menu group name in square brackets [xxx] can be found in the Edit menu to change data entries or the command keyword can be found in the Results menu to execute actions. In the Manual Mode, only the command keyword and parameter values need to be entered after the command prompt, followed by the OK button or ENTER key. For example, consider the entry below which might be found in the manual.

[Basic] → **VOLUMES 225 665 165** ...

In the Visual Mode, Basic should be selected from the Edit menu, then the VOLUMES item should be selected and the values entered, each followed by TAB, then the OK button. In the Manual Mode, following the command prompt, simply enter the "VOLUMES 225 665 165" information followed by a single ENTER key or the OK button. The result is the same in either case: VOLUMES values are set to the three values listed.

When an ellipsis "..." appears in this document, this indicates that the additional input fields which are displayed in the Visual Mode need not be entered, thus using any current/default values which are displayed. In the Manual Mode, the ellipsis is ignored (and should not be typed), thus retaining any current/default values which may exist. If an asterisk "*" appears separated from other characters, this means to skip over the input field for the asterisk to use/retain that field's current/default value.

Parameter Symbols

When discussing the use of SIGNAL2000 entries in the documentation or in using HELP in the program, descriptions of parameter values to be entered for each command will be shown enclosed by the angle bracket symbols, "<" and ">". A typical command keyword and parameter value HELP line is shown below:

FILES 5*<File Name>

In this example, FILES is the command keyword or menu selection to be used. The "5*" indicates that up to five <File Name> parameter values may be entered in the Visual Mode or on an input line. In the Manual Mode, these follow a typed FILES command, each separated by at least one blank. The number preceding the asterisk (five in this example) indicates the number of parameter values that may be entered on an input line for the command. In some cases, all parameter values must be entered, while in others only some are required. If all values are not entered, the ones not entered will remain unchanged.

This same HELP line is provided at the bottom of each dialog box for immediate on-screen HELP for the command line currently selected in the display. The F1 key or the Help button can be used to bring up the associated part of the on-screen manual. The *TEAPAC Tutorial/Reference Manual* gives extensive detail on how to enter parameter values in either the Visual or Manual Mode.

Review of TEAPAC Procedures

Before beginning the example problem in Chapter 2, it is worthwhile to review the basic procedures of running TEAPAC programs. There are four basic steps of an analysis using a TEAPAC program: Data Entry, Data Review, Analysis and Evaluation. This section briefly describes each step of this procedure which is used by all the TEAPAC programs. Additional detail can be found in Chapter 3 of the *TEAPAC Tutorial/Reference Manual*.

Data Entry

The first step in using any TEAPAC program is to enter the data required to describe the problem. This is normally accomplished using the Edit Menu and its sub-menus. Data may also be loaded from a disk data file (created earlier with the save options of the File menu) by using the Open option of the File menu. If a multi-scenario structure has been created in the file by the SCENARIO program, then a specific scenario case can be retrieved with the GetScenarioCase option of the File menu. TEAPAC programs contain default values for many of the parameter values; however, there are some parameter values which must be entered for each analysis to adequately define the problem. The dialog box display shows all of these default values.

Data entry may also be accomplished in the Manual Mode, particularly when a known and small group of command keywords are to be used. In this mode, the HELP command is useful in identifying those commands which can be used to enter these necessary parameter values. The commands can be entered directly with their parameters, or the ASK command can be used to generate a custom input/editing session with a specified sequence of dialog boxes (Normal View) or a specified list of input lines (Tabular View).

Before entering the detailed data above, the analysis network can be created on-screen in the main window with the use of the mouse in most TEAPAC programs (not in NOSTOP or TUTOR). Creating the network in this manner replaces the need to do it using the Edit menu (as above), and the network data can be edited further by additional mouse actions in the main window, or with the Edit menu. After the network is entered, the data for each intersection can be entered by right-clicking the intersection and using the same menus which appear in the Edit menu described above.

A network is created with the mouse by first clicking anywhere in the main window to reveal a grid with 500' spacing, then clicking the 'Create Link' button in the Edit Mode section of the left-side toolbar. In the Create Link mode, simply click down at the location of the beginning of the link (street), drag the mouse to the position of the end of the link, and release the mouse. A link terminated by two 'dummy' nodes will be shown. Any time a created link crosses an existing link, a 'real' analysis intersection is created and numbered in increasing order starting from #1. Dummy nodes are numbered in decreasing order starting from #999. In the 'Select Intersection' mode, the intersection which is clicked becomes the 'current' intersection for which any subsequent entered data will belong or results may pertain. The current intersection can also be selected with the Intersection dialog of the Edit menu or the Select Intersection toolbar button under the main menu (or with the ^-Home key combination). When dragging the mouse, the status bar at the bottom of the window shows the coordinate location of the mouse cursor, as well as the distance of the cursor from the 'current' intersection. Using the Pan & Zoom buttons allows the user to move around the network, as necessary.

If a bitmap file (.bmp) of appropriate resolution exists for the study area, (for example, an aerial photograph or map) that bitmap can first be identified and calibrated with the Setup button on the left-side toolbar. The file must be in the same folder that the data file (will) reside(s) in. If the data file already exists, and the bitmap has the same primary file name, then entering '*' as the bitmap file name will connect the two files automatically. Like data files, bitmap file names should not have more than 8 characters or have any spaces in the name. When creating a network from scratch, it is best to first calibrate the bitmap scale by entering a known distance and the number of pixels in the bitmap that represent that distance. The Click button to the right of the bitmap distance entry can be a convenient way to establish the pixel distance. For example, if the distance between two intersections on the bitmap is known, type that distance in the known distance field and use the mouse to click and drag a box with opposite corners located at those two intersections. A base point for the coordinate system can also be established with the translational relationship entries found in the top portion of the dialog. Once a network has been created, its shift and scaling can be modified by changing the same Setup dialog entries, or equivalently with the Anchor and Stretch buttons in the Adjust Display left-side toolbar.

Once a network has been created, the 'Move Intersection' Edit Mode button can be used to relocate any intersection or dummy node. By default, the link distance for all links connected to the moved node will be modified according to the move made. If the move is simply to better match the underlying bitmap and the link distances have already been entered and verified, the Adjust NETWORK checkbox in the Setup dialog should be unchecked to prevent the existing distances from being changed. (Each time the program is first run, this option is set to the selected status.) The 'Insert Bend Node' Edit Mode button can be used to create a dummy node on the link nearest to the click location so the network more precisely reflects curves in the network.

When creating legs to any intersection, use care to meet the standard TEAPAC requirement that each intersection can have only 4 legs and understanding that these legs will be assigned to the four positions North, East, South and West, regardless of their actual orientation. If two skewed

legs might be interpreted by the program to have an approach angle which assigns them both to the same leg of the intersection, initially create the legs with angles are such that they do not conflict, then Move the upstream external or bend node to correctly orient the leg visually.

Data Review

Once data has been entered, it should be checked for accuracy and correctness. In the Visual Mode, or when using the ASK command for input, this process is direct and immediate, since all of the current values of the entered commands are continuously displayed. The View-Summary menu is also a quick way to see all current data entries. In the Manual Mode, the TEAPAC commands DATA and SUMMARISE are used for data review. These commands display the current parameter values contained in the program. If no data has been entered for a command, its current values will be the default (RESET) values. If incorrect data is detected, it may be corrected using either of the data entry techniques described above. In the Manual Mode, the ASK command is frequently a good way to check data integrity, since it displays all values, and also allows immediate re-entry in the dialog box display if an error is found.

Analysis

The third step in program execution is to perform an analysis using the current parameter values. When satisfied with the accuracy of the program data, it is possible to use one or more of the commands in the Results Menu ([RESULTS] commands) to perform an analysis. All TEAPAC programs have one or more [RESULTS] commands which cause the program to act on the current data. These commands typically produce a report which displays the results of the analysis. Since more than one analysis may be required to generate the desired results, several [RESULTS] commands may be used at this step in the procedure.

Action commands can be executed by first selecting the Results Menu. This contains all of the action commands which are specific to SIGNAL2000. If the parameter values need to be changed first, they should be entered in the dialog, then the Execute button is pressed to execute the selected function.

In the Manual Mode, the action command need only be typed at the command prompt, followed by any desired parameter values to control the action, then the ENTER key or OK button.

Evaluation

After executing an action function(s), the results contained in the report(s) must be evaluated for reasonableness and to determine if subsequent analyses are required. Additional analyses may be necessary for a variety of reasons. One of the most common reasons for further analyses is to test adjustments to the input conditions. These could be in the form of simulated before and after studies or testing multiple scenarios. Another type of evaluation might be a sensitivity analysis to refine initial results or identify how a specific parameter value impacts the overall results. In any of these cases, the methods described above for data entry, review and analysis should be used.

CHAPTER 2

Initial Example

Chapter 2 Topics

In order to illustrate some of the basic commands and procedures essential to using the SIGNAL2000 program, as well as to provide some experience using them and observing the program's responses, an example problem has been developed which can be analyzed with the SIGNAL2000 program. Consider the following basic traffic problem.

Chapter 2 Topics:

Description of Example Problem

A small shopping center is to be constructed near an existing intersection. You are to analyze the existing P.M. peak hour conditions and determine the existing intersection and critical movement delay, as well as the best possible delay which could be achieved by adjusting the timings and/or the phasing. Then analyze the intersection to determine the impact on intersection and critical movement delay of the additional traffic generated by the shopping center. Assume an existing fifty-fifty split of a 120 second cycle, two-phase operation, with 4 second yellow times.

Existing turning movement counts have been taken for the P.M. peak hour conditions at the intersection. The existing volumes and available lane widths are shown in Table 2-1. The volumes added by the shopping center are indicated by the values appearing after the plus signs (+) in Table 2-1. Figure 2-1 shows the intersection lane configuration with existing movement volumes. Assume each lane is 12 feet wide.

Table 2-1
Peak Hour Turning Movements & Lane Group Widths For Example Problem

Approach	Movement	Volumes	Width	Approach	Movement	Volumes	Width
From North	Right Turn	175	12	From South	Right Turn	65+ 60	0
	Through	650	24		Through	370	24
	Left Turn	125+ 60	12		Left Turn	200	12
From East	Right Turn	60+ 60	0	From West	Right Turn	215	12
	Through	525+ 20	24		Through	450+120	24
	Left Turn	65+ 60	12		Left Turn	220	12

```
                                                              ^
                                                              |
                        FIRST STREET                          |
                                                              |
                |                         |                 North
                |   1    6   1            |                   |
                |   7    5   2            |               W --+-- E
                |   5    0   5            |                   |
                |                         |                   S
                |   |  |  |  |            |
                |   |  |  |  |            |
                |   |  |  |  |            |
________________| <-+  v  v  +->          |_______________
                                             ^
                                             |       60
                                           <-------
                                                    525
         BROADWAY                          <-------

                                           +-------  65
                                           v

               ^
   220 --------+

       -------->
   450
       -------->

   215 --------+
               v
________________                           ________________
                |             <-+  ^  ^   |
                |               |  |  |-->|
                |               |  |  |   |
                |               |  |  |   |
                |               |  |  |   |
                |                         |
                |               2    3  6 |
                |               0    7  5 |
                |               0    0    |
                |                         |
```

Figure 2-1
Schematic Diagram of Example Problem

Data Entry

If you are not currently running the SIGNAL2000 program, do so according to the way it was installed on your computer (see Appendix G). The program will display the program name along with important licensing information. As described in Chapter 1, two input modes can be used to manipulate the program. In the examples below, the Edit menu line to select in the Visual Mode is shown in square brackets, "[XXX]", and the command line to move to is shown following the arrow, "→". To enter the desired parameter values, move the cursor to the appropriate display

area and type the value in, followed by the TAB key. Use the OK button when done entering data to return to the Main Menu. To display more entries on a single dialog box, first select the Tabular View in the View menu before entering data using the Edit menu.

To use the Manual Mode for this tutorial, select the Manual Mode from the Options menu, or simply press F4. Once the program is ready to accept input, it will display the command prompt arrow. To enter the desired parameter values, enter the command keyword and parameter values, each separated by a space, all followed by the ENTER key. If the Visual Mode is desired at any point, simply press the F4 function key.

If you wish, you can use the drag-and-drop graphical network creation method to create your analysis network in the main window before entering detailed data. To do this, follow the instructions in the Data Entry section of Chapter 1. In this case, for a single intersection, simply draw two intersecting street segments. After the network is created, the additional detailed data described below can be entered by right-clicking on the intersection, including a check of the data already created by the drag-and-drop network creation. The intersection can also be re-numbered with a right-click option.

The first step in using any TEAPAC program is to enter the data required to describe the problem to be solved. This is accomplished using commands designated as [PARAMETERS] commands, such as VOLUMES and WIDTHS. The Commands option of the Help menu can be used to display help for all commands.

The Help-Commands menu displays all commands, along with information on how to use each. Note the number of parameters for each command and their associated default values. For example, the VOLUMES command requires volumes for the twelve (12*) possible movements at the intersection.

Since a lot of commands exist, getting HELP for a smaller group might be appropriate. The [BASIC] group consists of only those commands which are essential to solving problems with SIGNAL2000. These commands can be viewed by issuing the following command from the Manual Mode.

→ HELP [BASIC]

If help for only one command is needed, the HELP command will display the same detailed HLP file information for that command which is produced by the Help buttons in Visual Mode dialogs. For example, use the following Manual Mode entry to obtain complete help for the VOLUMES entry to be made in the next paragraph.

→ HELP VOLUMES

Now let's enter the information needed to describe the problem. The first entry should be the list of valid node numbers for any intersections we will be working with (NODELIST). This may be a system of connected signals in a network, or multiple conditions we want saved in a single file.

In any case, each intersection we study with TEAPAC must have a unique number in the NODELIST. For this example, we'll just set up one intersection in the list and call it #1.

[Basic] → **NODELIST 1**

The entries below describe the conditions at each individual intersection in the NODELIST. Note that the INTERSECTION command selects which intersection of the NODELIST the data that follows applies to. In the Tabular View, INTERSECTION is an active command which needs to be executed with the Execute button in order to change the screen's values to the new intersection.

[Basic] → **INTERSECTION 1**

Now we can enter the data which describes intersection 1. The first data entry could be the traffic volumes. When entering the VOLUMES parameters in the Visual and Manual Modes, SIGNAL2000 expects the data to be entered starting with the North approach right-turns and proceeding clockwise around the intersection as shown below. See Chapter 1 - Conventions for more detail.

[Basic] → **VOLUMES 175 650 125 60 525 165 65 370 200 215 450 220**

As with VOLUMES, the WIDTHS parameters also correspond to the twelve turning movements. In this case, note that if right- or left-turning movements do not have exclusive turn lanes, the WIDTH entry is zero and the turning volumes are automatically assigned to shared through lanes. If a turning movement has an exclusive lane in addition to a shared lane, see the discussion in Chapter 4 or Appendix B for dual optional turn lanes as entered by the GROUPTYPE command. Also note that the width given is for all lanes in each lane group. The number of lanes is deduced from these values on the LANES command.

[Basic] → **WIDTHS 12 24 12 0 24 12 0 24 12 12 24 12**

As an efficiency aid, one can move to the next dialog box in sequence as shown in the Edit menu with the Next button instead of using the menu each time. Thus, instead of pressing the OK button after the VOLUMES entry above and using the Edit menu to select WIDTHS, simply press the Next button.

The phase sequence is entered with the single SEQUENCES code for two-phase operation from Figure 1-2.

[Basic] → **SEQUENCE 11**

The GREENTIMES and YELLOWTIMES are entered in seconds for each of the two signal phases, with the north/south phase time first. In this analysis a 50/50 split has been assumed with four-second yellow times. The CYCLE length need not be entered since the timings are given in seconds.

[Basic] → **GREENTIMES 56 56** ...

[Basic] → **YELLOWTIMES 4 4** ...

The Tabular View is a particularly efficient data entry mode when lots of data is to be entered, but lacks some of the dialog box cues that the Normal View provides. Use the View menu (or the F3 key) and the Edit menu to explore this view and see the data values you have entered. If you have entered a value improperly, simply re-enter the proper value. The next section shows how you can verify all entries, particularly if you are using the Manual Mode.

Data Review

Once data has been entered, it should be checked for accuracy and completeness. In the Visual Mode, this process is simply a matter of reviewing the data entered in each dialog, since this reflects the actual current values. In the Manual Mode, DATA and SUMMARISE are used for this data review. Either of these commands may be used to display the current parameter values for the SIGNAL2000 entries. SUMMARISE provides a formatted summary report for all of the command parameter values, while DATA displays only the parameter values for the list of commands requested. To illustrate this operation, in either the Visual or Manual Modes, enter the following. Note that again, since this is an active command, the Visual Mode requires that the Execute button be used to execute the command. The View-Summary menu can also be used.

[Datafiles] → **SUMMARISE**

The current values of all input commands are listed with the values just entered, as well as any default values which were not entered. Note that the MOVEMENT parameters, such as VOLUMES, WIDTHS and LANES, have approach and movement labels and a report title is displayed. The DATA command only displays the information, without any special formatting.

[Datafiles] → **DATA VOLUMES WIDTHS**

The program displays the current parameter values for only the VOLUMES and WIDTHS commands. Note that no other command's values are listed, nor are there any headings. Since DATA accepts other commands as parameter values, DATA can be requested for only one, several or all commands, where SUMMARISE always gives all values. This makes DATA quicker to use, but less clear for others to review other than on the computer display.

The most efficient way to check input from the Manual Mode is to use the ASK command. This displays the current values of the commands "ASKed for" in a dialog box display which provides on-screen HELP and allows the user to move the cursor among the data fields and even change any values desired (just like the Visual Mode). Try the following from the Manual Mode, both in the Normal and Tabular Views (use F3 to toggle between views):

→ **ASK [BASIC]**

Review the data values listed using any of the methods described above. Note that there is an error in the VOLUMES entered. The left turn on the east approach should be 65, not 165. To correct this, re-enter the VOLUMES entry with the proper value using either of the entry modes, Visual or Manual.

[Basic] → **VOLUMES * * * * * 65** ...

Note that in either mode, only the value to be changed need be entered. In the Visual Mode, the cursor is moved to the field with the 165 value and the 65 is typed right over the 165, followed by TAB or ENTER. In the Manual Mode, the VOLUMES command is typed followed by 5 asterisks used as place holders to skip the first five entries.

It is frequently desirable to print the summary of input values, both as a document to use in the input checking process, as well as a physical record of the input data used in subsequent analyses. Use of the printer is easy with SIGNAL2000. Simply use the File-Print menu of the output window (or Ctrl-P) to direct the output to the default printer. Various available printers and printer options can be selected using the Setup options in the File menu, and the last produced output can be printed from the File menu of the main window. If your printer is connected, perform the above sequence for the SUMMARISE command to get a printed summary of input, then recheck all the data input for proper values before proceeding.

Analysis

The third step in program execution is to perform an analysis of the current data. Once satisfied with the accuracy of the input data, use the ANALYZE command in the Results menu to execute a SIGNAL2000 analysis.

[Results] → **ANALYZE**

The Capacity Analysis Summary report summarizes the basic input parameters as well as the results of the analysis. Note that the intersection delay listed at the top of the report is 26.4 seconds. This represents a weighted average for the total intersection, and individual approaches or movements operate with different delays. Note that the South and West left-turn movements have considerably higher delay, in the range of 56 to 62 seconds.

If more detail is desired for this analysis, the 2000 *Highway Capacity Manual* worksheets can be produced by the ANALYZE command if preceded by the OUTPUT command to select worksheet output. These options can be found in the Edit and Results menus, as before.

[System] → **OUTPUT FULL** ...

[Results] → **ANALYZE**

Note how the same results as before are produced, but with a much higher level of detail. Let's turn the worksheet output back off so we don't create too much output for the remainder of the examples.

[System] → **OUTPUT NONE** ...

An important function of the SIGNAL2000 program is the design or optimization of intersection control. This is accomplished in the Usage Level 2 (and higher) versions of SIGNAL2000 by checking many combinations of signal phasing and cycle length, producing optimum green times for each combination, and checking the level of service of the critical movements. The DESIGN command is used to optimize phasings and timings in the Usage Level 2+ version of the program. First setting the SEQUENCES command to ALL allows DESIGN to optimize and rank all possible phasings. The CYCLES command should be used to scan a wide range of possible cycle lengths. Note that the demo version of SIGNAL2000 will only allow 16 sequences rather than 64, and the cycles cannot be changed.

[Basic] → **SEQUENCES 11 ALL**

[Basic] → **CYCLES 60 120 30**

[Results] → **DESIGN** ...

Two reports are generated by this DESIGN command, an Optimum Phasings summary and a Capacity Analysis Summary. The Optimum Phasing summary is a listing of the performance of 64 different phase operations ranked in the order of performance from best to worst. The Capacity Analysis Summary contains the results of the analysis for the first or "best" SEQUENCE in the Optimum Phasings summary, SEQUENCE 47. When reviewing the Capacity Analysis Summary, note that the intersection delay is 40.4 seconds, higher than before, but the critical movements operate with a balanced amount of delay which is about 45 to 47 seconds, a better solution than previously. This illustrates the importance of keeping our focus on critical movement delay, not intersection delay.

It may be of interest to know how well the intersection will operate if timed best with the existing phasing. This is easily done by selecting the optimum TIMINGS already DESIGNed for the existing phasing and producing a capacity analysis. This is done with the following commands.

[Results] → **TIMINGS 11** ...

[Results] → **ANALYZE**

Review the Capacity Analysis Summary. Note that the intersection delay has gone down to 17.5 seconds since the two-phase signal has less lost time, but that the critical movements delay is up

to about 50 seconds. This is clearly better than the original timings, but the critical movements are not as good as when controlled under the best possible phasing.

Evaluation

One powerful aspect of TEAPAC software is the capability to quickly test multiple scenarios or conditions in an interactive environment. To test the impact on the intersection due to the increase in traffic generated by the new shopping center, use the new optimum timings (which are currently in the GREENTIMES and YELLOWTIMES commands) for the existing phasing with the new volumes.

[Basic] → **VOLUMES 175 650 185 120 545 125 125 370 200 215 570 220**

[Results] → **ANALYZE**

With the addition of the shopping center traffic, the intersection delay went up to 20.4 seconds and the critical movements have delays as high as 50 and 89 seconds. Since the ANALYZE command was used, no changes were made to the GREENTIMES from the previous analysis. On the other hand, it is possible to use the DESIGN command to generate new timings and phasings which would improve the operation under the new traffic volumes. This can be easily accomplished by using the DESIGN command again.

[Results] → **DESIGN** ...

The result is now sequence 44 with intersection delay of 41.2 seconds, but the critical movements' delay is now equalized at 48 to 49 seconds.

While the example problem is over-simplified, it does demonstrate that SIGNAL2000's interactive analysis and design techniques allow many conditions to be tested quickly and efficiently. In addition, printed reports can be produced to document the analysis, and analysis conditions can be saved at any time, as illustrated below.

At this point of the analysis, we may feel we have an adequate solution to the problem, and wish to SAVE the data values which created the final results for future use. The typical Save/SaveAs options of the File menu are normally used, but the [DATAFILES] commands of the File menu also offer these capabilities by first defining the disk FILE name to be used for storage, then issuing the SAVE command to save the parameter values.

[Datafiles] → **FILES SAMPLE/N** ...

[Datafiles] → **SAVE 1 1** ...

Note that the file name "SAMPLE" has a "/N" switch added to its name the first time it is used to indicate to SIGNAL2000 that you expect to create a new file. This is not required, but saves the

steps of responding to the new file creation query. When used, an error will be produced only if this file name already exists. Other such switches and file name conventions are discussed in Appendix G, as they relate to your operating system. Also note that as many as five files can be named at any given time, and that the SAVE command describes which of these five files are to be used. The SAVE command can also tell the program where in the file to save information, allowing different scenarios to be stacked one after the other in the same file. The LOAD command is used to retrieve the information at a later date. All of these options relate to advanced file manipulation capabilities such as batch control file scripts and multiple scenarios, described in detail in the *TEAPAC Tutorial/Reference Manual*.

Exiting the Program

Additional experiments may be conducted at this point. When finished, the Exit option of the File menu can be used. In the Manual Mode, the STOP (or QUIT) command can also be used.

[Control] → **STOP** ...

Control of the computer is returned to the operating system. This step is not necessary if you will continue with the examples of Chapter 3.

Additional Concerns

The procedures and commands presented in this chapter are representative of the functions which can be performed using the SIGNAL2000 program. A number of important aspects were not presented in the interest of simplifying the example problem. Specifically, default values were used for many of the possible parameter values of the program. These parameter default values may not be appropriate for the conditions to be studied and thus may require modification.

For example, one default parameter not addressed in detail by the example was the CYCLES command. This command controls the range of cycle lengths tested in the DESIGN function. The CYCLES command default values are such that only cycle lengths of 60, 90 and 120 seconds are tested. Multiple iterations, varying the range of cycles and the increment, are typically required to determine the optimal cycle length for an intersection.

These procedures, as well as other important elements of the complete use of the SIGNAL2000 program, are discussed in detail in Chapters 3, 4 and 5, and should be addressed as soon as you are comfortable with the basic elements discussed in this initial example.

CHAPTER 3

Analysis Procedures

Chapter 3 Topics

Having stepped through the example problem in Chapter 2, it is now possible to discuss in greater detail the actual procedures and entries used to perform analyses using the SIGNAL2000 program. This chapter discusses the minimum input requirements to conduct a reasonable analysis, as well as practical limitations of the program. Then appropriate analysis procedures are explained. This chapter is designed to fully explain the operation of the SIGNAL2000 program and provide additional understanding of the example shown in Chapter 2.

Chapter 3 Topics:

Input Requirements

This section discusses the basic input requirements for SIGNAL2000. It begins with a discussion of the minimum input requirements to produce various reports, and then discusses the limitations to data input which exist. This section is quite important in that it sets the minimum information for valid results, as well as the limitations of the program.

Minimum Input Requirements

Many of the input parameter values have defaults which eliminate the need to enter data for every parameter. After the program is started or the File-New menu or RESET [PARAMETERS] command is issued, these default values can be viewed in any of the input dialogs of the Visual Mode or with the DATA or ASK commands in the Manual Mode. The default values of each command are also listed in the right-hand section of the HELP displays which are generated by the Help-Commands menu or the HELP command in the Manual Mode.

On the other hand, there are several commands for which it is necessary to input data in order to produce legitimate results. The most obvious of these are the VOLUMES and WIDTHS commands to describe the demand volumes and lane geometries. Values for these commands are needed to do most any function of the SIGNAL2000 program. As such, examples of these inputs were illustrated in the initial example of Chapter 2. For a planning level analysis, this may be adequate to describe the situation which is to be analyzed. For a more detailed operations analysis, the other commands which describe intersection conditions should be used, although each has a preset default value which is frequently usable in an analysis. Each of the input parameters for these commands should be reviewed to check the appropriateness of the default values.

The SIGNAL2000 program has two basic modes of operation, one where a capacity analysis of a complete set of given conditions is desired, the other where an optimum operation of the signalized intersection is desired. These are commonly referred to as the ANALYZE and DESIGN modes, following the names of the two basic commands which are used in these modes. The DESIGN mode is only available in the Usage Level 2+ versions of the program, while the ANALYZE mode is available in all levels of SIGNAL2000. The input requirements for these two modes are noticeably different, and thus are discussed below in separate sections.

In either mode, if an intersection has been selected with the INTERSECTION entry as we did previously, the actions requested will be performed for that intersection only. If all intersections have been selected by selecting INTERSECTION 0, then the actions requested will be performed for all intersections in the NODELIST, one by one in the order listed in the NODELIST. If a SUBSYSTEM entry has been made (Usage Level 3+), then when INTERSECTION 0 is selected the actions will be performed only for the SUBSYSTEM intersections and in the order these intersections are found in the NODELIST.

ANALYZE Inputs. The ANALYZE mode means that a complete set of conditions are given in order for the program to produce a capacity analysis. This means that in addition to the basic intersection conditions mentioned above, including the VOLUMES and WIDTHS, the signal phasing and timings must be specified. This requires that the SEQUENCES command be used to specify the phasing according to the sequence code method discussed in Chapter 1, and that GREENTIMES and YELLOWTIMES be given for each phase. If the GREENTIMES and YELLOWTIMES are given in proportions of the cycle time (numbers less than 1.00), then the cycle length must be explicitly stated on the CYCLES command (as the first parameter). When timings are all given in seconds, no cycle time entry is required since the cycle time will be computed as the sum of all phases greentimes and yellowtimes.

The EVALUATE command can be used in the same fashion as the ANALYZE command described above, and requires exactly the same inputs as ANALYZE. The only difference is in the type of results which are computed. The EXPORT command also has the same input requirements as ANALYZE, with the exception that if certain information is missing, it will simply be omitted from the HCS file that is created, and this information can be entered later in

HCS, if needed. VOLUMES and WIDTHS are still required in order that SIGNAL2000 can create a meaningful data file for HCS.

Three other commands can be used in the same fashion as ANALYZE, when phasings and timings are known. These are the QUEUECALCS, SERVICEVOLS and GOVERCS commands. QUEUECALCS computes queue lengths using a variety of published methods for the specified phasing and timing. SERVICEVOLS computes the saturation flow rates (in vehicles per hour of green, e.g., for 100% green time) for every defined lane group, assuming the specified phasing and timing. GOVERCS computes the greentime required by each lane group to satisfy each specified LEVELOFSERVICE. This calculation is done internally for each DESIGN command, and can be used to perform manual designs for complicated situations SIGNAL2000 cannot handle.

DESIGN Inputs. The DESIGN mode of Usage Level 2+ means that any of the phasing, cycle length and phase timing parameters may be unknowns, and that SIGNAL2000 is to optimize these parameter values within the stated constraints of the inputs. When the DESIGN command is used, any input GREENTIMES and YELLOWTIMES are completely ignored and the optimum greens and yellows are determined by SIGNAL2000. These optimum timings are constrained by the MINIMUMS and REQCLEARANCES command values which place these timing requirement constraints on the determination of the optimum timings.

If the cycle length is a known value, the CYCLES command should show this as both the minimum and maximum cycle length to be DESIGNed, in which case the DESIGN command will determine the best possible timings for that cycle length. If a range of cycle lengths is acceptable, this range should be denoted on the CYCLES command prior to the DESIGN, using an appropriate cycle increment, in which case DESIGN will attempt optimizations for all of the cycles allowed.

If the phasing is a known sequence, the SEQUENCES command should show this as the only sequence to be DESIGNed, in which case the DESIGN command will determine the best possible timings for that sequence of operation, as well as the allowed range of cycles. If a number of sequences are allowed, as in the case of an actuated controller or the design of a new controller, the allowed sequences should be listed in the SEQUENCES command, and DESIGN will optimize all of the sequences for the allowed range of cycles. If the single keyword ALL is used on the SEQUENCES command, DESIGN will optimize every possible sequence code for the allowed range of cycles. Additional shortcuts are allowed with SEQUENCES to specify typical lists of phasings which should be allowed.

Thus, the DESIGN command can be used to optimize timings for a known phasing and cycle length as well as a complete range of phasings and cycles, as controlled by the SEQUENCES and CYCLES commands.

Two other inputs also control the DESIGN process. These are the LEVELOFSERVICE and EXCESS commands. The LEVELOFSERVICE command describes the desired level of service, delay or v/c which DESIGN will attempt to achieve for the critical movements. If this level of

performance is achieved, the additional time which is available is defined as excess time, and its allocation to the phases is defined by the EXCESS command. The EXCESS command provides the movement numbers which are to receive any excess time which may be available. If no movement numbers are given, the default is to assign any excess time to all phases in proportion to the required time for each phase. If the desired level of performance is not met, the EXCESS command is ignored.

Other Commands. Two other commands fall into a utility category, being usable at almost any time during the course of an analysis. These are DIAGRAM and MAP. DIAGRAM produces a phasing diagram for the specified phasing code, and only requires that the proper VOLUMES and WIDTHS be entered so that it can display an arrow in any phase where the movement exists and is allowed. MAP displays the input values of the VOLUMES, WIDTHS, LANES, SEQUENCE, LEADLAGS, PERMISSIVES and OVERLAPS commands, and as such, these inputs should be made prior to its use.

Input Limitations

SIGNAL2000 is designed to analyze and optimize the operation of as many as 500 typical four-legged intersections using the techniques described in the 2000 *Highway Capacity Manual* as a basis for the analyses. In accomplishing this objective, certain limitations in the input and use of the program exist. These are described in this section. In some instances, references to Chapter 5 are made where techniques are described to get around some of these limitations. None of these limitations constrain the basic use of the program for most situations, however, and this section should not be viewed as diminishing the usability of the program, but merely documenting the limitations which should be observed in its use.

Usage Level 4 of SIGNAL2000 allows the definition of up to 500 intersections. Smaller problems can also be defined with this large version of SIGNAL2000. Usage Level 3 of SIGNAL2000 will allow the definition of up to 100 intersections for a single analysis, and Usage Level 2 of SIGNAL2000 will allow the definition of up to 12 intersections for a single analysis.

As many as four approaches can be analyzed for each intersection as long as they generally follow the geometric layout of two crossing two-way streets. The primary concern here is that the designated left turns conflict with through movements on the opposite approach as in a normal four-way intersection, since these are what the pre-coded sequences address. Additional legs of a multi-leg intersection can be handled through use of special techniques described in Chapter 5.

Sixty-four distinct phasings can be handled automatically through use of the standard TEAPAC phase sequence numbering scheme described in Chapter 1. When these phasing codes are used, all facets of the program can be used without limitation. Through use of negative sequence codes (-1 thru -9) and the PHASEMOVEMENTS command, completely arbitrary phasings can be handled by the ANALYZE and EVALUATE commands, as long as the rules of describing the phasing are followed for the PHASEMOVEMENTS command. The DESIGN and EXPORT commands will not function when negative SEQUENCE codes are used.

In terms of input parameter limits, those limits which are described in the 2000 *Highway Capacity Manual* are specifically allowed for each parameter value. In some cases, greater input limits are allowed and the methods of the 2000 *Highway Capacity Manual* are extrapolated, as appropriate, sometimes with advisory warning messages. Specific input limitations for each command input are described in Appendix B under each of the command names used for the input.

Analysis Procedures

When using SIGNAL2000, it is important to understand the fundamentals of how the data entries and actions are used together in order to get results in an efficient and accurate manner. In the example in Chapter 2, certain processes produced specific results. In this section, these steps are reviewed and discussed in detail to provide a more complete understanding of the program functions. First the basic analysis procedures are outlined, then more specialized procedures are described. Chapter 5 describes unique ways that these basic and special procedures can be combined to solve unusual problems with SIGNAL2000.

Basic Analysis Procedure
Special Analysis Procedures

Basic Analysis Procedure

As described above, SIGNAL2000 has two primary analysis modes, ANALYZE and DESIGN. Since these modes of use differ greatly, each is discussed individually below.

ANALYZE Procedures. In performing a capacity analysis, the basic method of doing the analysis is to enter the parameters which describe the intersection conditions, phasing and timings, as described in the Input Requirements above, then follow this with the ANALYZE command. If HCM worksheets are desired, the ANALYZE command should be preceded by the OUTPUT command. These entries and actions are done with the Edit and Results menus, respectively.

In the Manual Mode, all the same steps can be performed by simply entering the commands desired with their appropriate parameter values. The end of Chapter 3 of the *TEAPAC Tutorial/Reference Manual* describes how the ASK command can be used in the Manual Mode to further enhance the process of performing iterative tabulations and analyses, especially when using the special group names described in Appendix A of this document.

If an intersection has been selected with the INTERSECTION entry, the ANALYZE actions will be performed for that intersection only. If all intersections have been selected by selecting INTERSECTION 0, then the actions will be performed for all intersections in the NODELIST or SUBSYSTEM, as described earlier.

DESIGN Procedures. In performing a phasing and/or timing optimization in a Usage Level 2+ versions of SIGNAL2000, two basic methods of doing the design can be used. In either case, the parameters which describe the intersection conditions should be entered as described above for the ANALYZE mode and in the Input Requirements section above. This input should then be followed by the DESIGN command using its single controlling parameter input. The two design modes are defined by whether the DESIGN parameter is zero or not. When the DESIGN parameter is greater than 0 (usually 1, the default), this instructs SIGNAL2000 to optimize all combinations of the CYCLES and SEQUENCES, to pick out the "best" phasing(s) and to produce a capacity analysis of the best timings for that phasing(s). The number of phasings for which capacity analyses will be produced is the number entered as the DESIGN parameter. This is commonly referred to as the Intersection Design Study mode of DESIGN, where the actual phasing which is selected is not as important as the capacity analysis of the "best" phasing. This DESIGN mode will work for either a specific INTERSECTION, or for all intersections (INTERSECTION 0).

If the DESIGN parameter value is zero, no capacity analyses are performed. In this case, only the DESIGN is performed for every combination of CYCLES and SEQUENCES, with a progress report of the DESIGN as the result. This process should be followed up with a SORT command which will detail the DESIGN results, also listing the sequences designed in order from best to worst. From this list, the preferred sequence can be selected with the TIMINGS command, which automatically "selects" the preferred sequence by placing it first in the SEQUENCES list, and then dumps the best GREENTIMES, YELLOWTIMES and CRITICAL movements into the corresponding commands for subsequent use by the ANALYZE, EVALUATE, QUEUECALCS or EXPORT commands. When the selection of the real "best" phasing is crucial, this use of DESIGN is preferred, since it gives the user control over the identification of the optimum phasing, giving consideration to non-quantifiable selection criteria SIGNAL2000 cannot consider. The use of INTERSECTION 0 (for all intersections) can be used with DESIGN 0 as long as its result is the only DESIGN result desired. If DESIGN 0 is to be followed by SORT and/or TIMINGS, the DESIGN 0 must be done for a single intersection since the DESIGN 0 function will only ‘remember’ the last DESIGN which it has performed.

In summary, when phasings and/or timings are being DESIGNed, two methods can be employed. 1) When the determination of the best phasing is not crucial, the quickest way to perform a DESIGN is by entering a DESIGN 1 or DESIGN 2 command, thereby producing a capacity analysis of the best timings for the best 1 or 2 phasings with a single command. In this case, the only output is the sorted list of sequences and the capacity analysis, with or without the worksheets, as directed by the OUTPUT command. When this method is used, the sorted list should be reviewed to make sure the program's selection of the "best" phasing has merit. INTERSECTION 0 may be used effectively under this method. 2) When the selection of the best phasing is more important, the same process can be executed in a step-by-step fashion, using in sequence, the DESIGN 0, SORT, TIMINGS and ANALYZE commands. In this case, the selected phasing from the SORT list is used on the TIMINGS command. After execution of the TIMINGS command, the SEQUENCES, GREENTIMES, YELLOWTIMES and CRITICAL commands are updated automatically, putting the user in a position to execute any of the other ANALYZE mode commands, such as ANALYZE, EVALUATE, QUEUECALCS and

EXPORT. EXPORT sends the optimized information to a data file to perform a comparable HCS capacity analysis of the SIGNAL2000-optimized phasings and timings. These entries and actions are done with the Edit and Results menus, respectively. INTERSECTION 0 may not be used under this method, except when only the initial DESIGN 0 is performed.

In the Manual Mode, all the same steps can be performed by simply entering the commands desired with their appropriate parameter values. The end of Chapter 3 of the *TEAPAC Tutorial/Reference Manual* describes how the ASK command can be used in the Manual Mode to further enhance the process of performing iterative tabulations and analyses, especially when using the special group names described in Appendix A of this document.

Special Analysis Procedures

SIGNAL2000 also has several special computations which can be performed. These computations can augment the basic ANALYZE and DESIGN procedures described above. Each is discussed below. Remember that means of using SIGNAL2000 for computations relevant to solving unusual problems and situations are described in Chapter 5. This section merely describes additional computations which can be performed directly by SIGNAL2000.

Saturation Flow Calculations. When only estimates of the saturation flows are needed, these computations can be performed without the need to produce a complete capacity analysis. This can be particularly convenient in that a capacity analysis requires that every worksheet be produced in order to get the saturation flow worksheet (which is all that is desired). Using the SERVICEVOLUMES command will produce a single table of computed saturation flows for every defined lane group. This command can be executed at any time that the intersection conditions have been input, in much the same way that ANALYZE can be used. Input phasings and timings are required.

Required G/C Calculations. The GOVERCS (pronounced gee-over-seez as in g/C) command can be issued at any time intersection conditions have been input to estimate the amount of greentime which is required to meet the desired levels of service. These computations are performed for every LEVELOFSERVICE specified. These computations can be quite useful when trying to solve capacity problems at an intersection, or for generating optimum timings for a non-standard phasing for which DESIGN will not function. This command can be used anytime use of the ANALYZE command would be valid.

CHAPTER 4

Actions and Entry Parameters

Chapter 4 Topics

This chapter provides a summary description of all of the actions and entry parameters of the SIGNAL2000 program. The usage format of each command dialog and associated parameter values are provided along with a functional description of the command dialog. The dialogs are grouped and presented in the following three logical categories:

- [RESULTS] Dialogs - action commands for SIGNAL2000 found in the Results menu which are specific to the act of solving the traffic problem addressed by the SIGNAL2000 program, and used to control the type of analysis performed.

- [PARAMETERS] Dialogs - entry commands for SIGNAL2000 found in the Edit menu which are specific to the process of entering data for the traffic problem to be solved by the SIGNAL2000 program.

- Common TEAPAC Dialogs - entry and action commands of the SIGNAL2000 program which are common to and used by all of the TEAPAC programs. These are found primarily in the Datafiles and Control sub-menus of the File menu.

Table 4-1 describes the detailed organization of how each of the SIGNAL2000 commands is presented in this chapter, according to these categories.

Table 4-1
Organization of Command Discussions

RESULTS Dialogs
PARAMETERS Dialogs
- Commands to Enter Basic Data
- Commands to Enter System Data
- Commands to Enter Intersection Data
- Commands to Enter Approach Data
- Commands to Enter Movement Data
- Commands to Enter Phasing Data
- Commands to Enter Traffic Generator Data
- Commands to Enter Traffic Count Data

Common TEAPAC Dialogs
- Commands to Aid Interactive Input of Data
- Commands to Label Output
- Commands to Control Operation of Program
- Commands to Access Data Stored in Files
- Commands to Control Program Execution

For each command discussed, the first line of a command header provides the basic usage format of the command dialog, as shown in the sample format below:

COMMAND **<Parameter Value> 5*<Another Parameter>**

Parameter values which are enclosed by angle brackets, "<" and ">", indicate that the bracketed description is to be replaced by a parameter value as described. If a command requires more than one parameter value of the same type, this is represented by an asterisk, "*", preceded by the number of entries expected or allowed. In the example above, as many as five of <Another Parameter> can be entered. This command header is then followed by a summary which describes the main purpose of the command. Details of the command's usage are found in Appendix B.

Remember that each SIGNAL2000 command has been classified into one or more "groups" which share functional similarities. Appendix A provides a tabular summary of all commands assigned to each command group. Appendix B provides a detailed table of information for each command, listed in alphabetical order. Appendices A and B can be used as reference documents when questions arise regarding any given group or command. Refer to Chapter 4 - TEAPAC Command Structure in the *TEAPAC Tutorial/Reference Manual* for a detailed discussion of group names and their uses.

Chapter 4 Topics:

PARAMETERS Dialogs
Common TEAPAC Dialogs

RESULTS Dialogs

[RESULTS] commands are the active command dialogs which perform the various analyses specific to the purpose of the SIGNAL2000 program. These commands are summarized in this section. All the details about each command dialog can be found alphabetically in Appendix B. The data entry values which must be made prior to using the active commands are listed in the following section.

DESIGN **<Number of Sequences to Analyze>**
Perform an operational design to optimize timings for each sequence of the SEQUENCES command and each cycle of the CYCLES command for the current intersection or all intersections. This is a Usage Level 2+ command.

SORT **<Priority> <Output>**
Display the DESIGNed sequence codes and performance levels in order from best to worst performance as previously DESIGNed for the current intersection.

TIMINGS **<Sequence Code> <Output>**
Retrieve the optimum timings for the sequence code specified from previously DESIGNed results for the current intersection.

ANALYZE **--**
Perform a capacity analysis of a specified phasing and timings for the current intersection or all intersections.

EVALUATE **--**
Display a performance evaluation for a specified phasing and timings for the current intersection or all intersections.

QUEUECALCS **--**
Display a wide variety of various published queue calculations for a specified phasing and timings for the current intersection or all intersections, including the 2000 *Highway Capacity Manual* queue model.

EXPORT **<File name/AUTO>**
Create an HCS-compatible input data file from the current data values for the current intersection, with an optional automatic link to HCS.

GOVERCS **--**
Compute g/C's required to make each movement operate at specified levels of service for the current intersection or all intersections.

SERVICEVOLUMES **--**
Compute the saturation flow rate (previously called service volumes) for each movement for the current intersection or all intersections.

DIAGRAMS **<Sequence Code>**
Display a phase movement diagram for the specified sequence code for the current intersection.

MAP **--**
Display a schematic map of the intersection identifying the twelve turning movement volumes as well as widths and lanes for the current intersection or all intersections.

PARAMETERS Dialogs

[PARAMETERS] commands are the data entry command dialogs used to enter the parameter values which are specific to the purpose of the SIGNAL2000 program. Each is summarized in the following paragraphs. First, those [PARAMETERS] commands which are the most basic entry commands are described. These commands are frequently the only ones needed to describe intersection conditions completely, using the defaults for the remaining [PARAMETERS] commands. These remaining commands are then described, organized by the type of inputs they represent, including the basic commands. All the details about each command dialog can be found alphabetically in Appendix B.

Commands to Enter Basic Data

The following are the commands which are used to enter the basic data to describe the problem to be solved.

NODELIST **500*<Node Number>**
Enter the list of nodes to be studied, as well as the order of the analysis.

INTERSECTION **<Node #> <Description>**
Select from the NODELIST the node number of the "current" intersection, and optionally enter an intersection description.

METROAREA **<Location>**
Enter the location of the current intersection within the metropolitan area.

APPLABELS **4*<Approach Label>**
Enter labels for each approach of the current intersection.

PARKINGSIDES **4*<Parking Location>**
Enter parking conditions on each approach of the current intersection.

PARKVOLUMES **4*<Parking Volume>**
Enter the number of parking maneuvers per hour on each side of each approach of the current intersection.

MOVLABELS **12*<Movement Label>**
Enter abbreviated labels for each movement of the current intersection.

VOLUMES **12*<Design Hour Volume>**
Enter the turning and through movement volumes for each of the movements of the current intersection.

WIDTHS **12*<Lane Group Width>**
Enter the width of the lane group for each movement of the current intersection.

LANES **12*<Number of Lanes>**
Enter the number of lanes which are assigned for use by each of the twelve movements of the current intersection

TRUCKPERCENTS **12*<Truck-Through Bus Percentage>**
Enter the truck and through bus (heavy vehicle) traffic percentage for each movement of the current intersection.

PEAKHOURFACTORS **12*<Peak Hour Factor>**
Enter the peak hour factor for each movement of the current intersection.

ARRIVALTYPES **12*<Quality of Progression>**
Enter the quality of progression for each movement of the current intersection.

ACTUATIONS **12*<Actuated Movement>**
Enter the type of phase module present, actuated or non-actuated, for each movement of the current intersection for use in the determination of the Delay Calibration Term (k).

MINIMUMS **12*<Minimum Green Time>**
Enter the minimum green time requirements for each of the twelve movements of the current intersection.

REQCLEARANCES **12*<Required Clearance>**
Enter the clearance times required for each movement of the current intersection.

SEQUENCES **<Sequence Code> <List of Possible Sequence Codes>**
Enter the desired and allowed phasings of the traffic signal of the current intersection according to the codes defined in Figure 1-2 of Chapter 1.

CYCLES **<Minimum Cycle> <Maximum Cycle> <Cycle Increment>**
Enter the range and precision of cycle length scanning for the current intersection for DESIGN, as well as the default cycle length for the ANALYZE, EVALUATE, QUEUECALCS, SERVICEVOLUMES, GOVERCS and EXPORT commands.

GREENTIMES **6*<Phase Green Time>**
Enter the duration of green for each of the phases of a specified phase sequence, or optionally for each of the movements, of the current intersection.

YELLOWTIMES **6*<Phase Yellow Time>**
Enter the clearance interval at the end of each phase of a phase sequence, or optionally for each of the movements, of the current intersection.

Commands to Enter System Data

The following are commands which can be used to describe the system which is being analyzed. Each of these commands has parameters which apply to the entire system. Some of these commands were also included in the Basic Data discussed above.

NODELIST **500*<Node Number>**
Enter the list of nodes to be studied, as well as the order of the analysis.

SUBSYSTEM **500*<Node Number>**
Enter the subset of the NODELIST for which subsequent actions should be taken.

ROUTE **<Route #> <List of Artery Nodes>**
Enter a list of node numbers which represent the intersections on the artery for the given route number.

MASTERNODE **<Master Node #>**
Enter the node number of the intersection which is the master node location for the system or subsystem.

QUEUEMODELS **<Model #> <Percentile> <Auto> <Truck>**
Enter parameters which control the queue model calculations used for all intersections under study.

SIMULATION **<Steps/Cycle> <Analysis Period> <Stop Penalty> <Link Numbering Method> <Model Actuated> <Assignment Method>**

Enter simulation control parameters, including the length of the analysis period for all intersections under study.

OPTIMIZE **<Optimization Type> <Step Size List>**
Enter the type of system optimization to be performed by TRANSYT or PASSER.

OUTPUT **<Prog> <Worksheets> <Messages> <Design/Evaluate>**
Enter flags regarding whether or not to display ANALYZE/EVALUATE/QUEUECALCS worksheets, warning messages and additional DESIGN/EVALUATE information.

Commands to Enter Intersection Data

The following are commands which can be used to describe the current intersection. Each of these commands has parameters which apply to the entire intersection. Some of these commands were also included in the Basic Data discussed above.

INTERSECTION **<Node #> <Description>**
Select from the NODELIST the node number of the "current" intersection, and optionally enter an intersection description.

NODELOCATION **<X-Y Coordinates>**
Enter the X and Y coordinates of the current intersection.

METROAREA **<Location>**
Enter the location of the current intersection within the metropolitan area.

NETWORK **<Direction> <Distance> <Speed> <Node #> 4*<Movement #> <Assignment Method> <Curvature> <Manual Distance>**
Enter the current intersection's relative location in the system network, including spatial and speed parameters.

LEVELOFSERVICE **<Target Delay/LOS> <Max Delay/LOS> <Delay Incr> <Target v/c> <Max v/c> <v/c Incr>**
Enter the range of delay (or level of service) and v/c which should be tested by a DESIGN optimization and GOVERCS for the current intersection.

EXCESS **<List of Priority Movement Numbers>**
Enter the movements to which the TIMINGS command will assign available excess portions of the cycle length for the current intersection.

Commands to Enter Approach Data

The following are commands which can be used to describe each approach of the current intersection. Each of these commands has four parameters, each applying to all traffic on each of the intersection's approaches. The order of entry is clockwise, starting at the north approach, e.g.,

first from the North, then from the East, then from the South, then from the West. Some of these commands were also included in the Basic Data discussed above.

APPLABELS **4*<Approach Label>**
Enter labels for each approach of the current intersection.

GRADES **4*<Grade of Approach>**
Enter the grade of each approach of the current intersection.

PEDLEVELS **4*<Pedestrian Interference>**
Enter the level of pedestrian interference for right turns on each approach of the current intersection.

BIKEVOLUMES **4*<Conflicting Bicycles>**
Enter the volume of conflicting bicycles for right turns on each approach of the current intersection.

PARKINGSIDES **4*<Parking Location>**
Enter parking conditions on each approach of the current intersection.

PARKVOLUMES **4*<Parking Volume>**
Enter the number of parking maneuvers per hour on each side of each approach of the current intersection.

BUSVOLUMES **4*<Stopping Bus Volume>**
Enter the volumes of stopping buses which stop on each approach of the current intersection.

RIGHTTURNONREDS **4*<Right Turn on Red Volume>**
Enter the right turn on red volume for the right turns on each approach of the current intersection.

UPSTREAMVC **4*<Upstream v/c Ratio>**
Enter the v/c ratio of the upstream intersection for each approach of the current intersection.

Commands to Enter Movement Data

The following are commands which can be used to describe each movement of the current intersection. Each of these commands has twelve parameters, each applying only to traffic on each of the intersection's individual movements. The order of entry is clockwise, starting with the right turn on the north approach, e.g., first RT from the North, then TH from the North, then LT from the North, then RT from the East, etc., up to the LT from the West. Some of these commands were also included in the Basic Data discussed above.

MOVLABELS **12*<Movement Label>**
Enter abbreviated labels for each movement of the current intersection.

VOLUMES **12*<Design Hour Volume>**
Enter the turning and through movement volumes for each of the movements of the current intersection.

VOLFACTORS **<# Years> 12*<Adjustment Factor>**
Enter number of times to compound and each multiplier used for each movement to adjust the volume or count data entered at the current intersection.

VOLADDITIONALS **<AddFactor> 12*<Additional Volume>**
Enter the factor and additional volume to be added for each movement of the current intersection.

WIDTHS **12*<Lane Group Width>**
Enter the width of the lane group for each movement of the current intersection.

LANES **12*<Number of Lanes>**
Enter the number of lanes which are assigned for use by each of the twelve movements of the current intersection

GROUPTYPES **12*<Lane Group Type>**
Enter the special lane group type for each possible lane group of the current intersection, such as dual-optional lanes, free-flow lanes and sign-controlled lanes.

UTILIZATIONS **12*<Lane Utilization Factor>**
Enter the lane utilization factor for each movement of the current intersection.

TRUCKPERCENTS **12*<Truck-Through Bus Percentage>**
Enter the truck and through bus (heavy vehicle) traffic percentage for each movement of the current intersection.

PEAKHOURFACTORS **12*<Peak Hour Factor>**
Enter the peak hour factor for each movement of the current intersection.

ARRIVALTYPES **12*<Quality of Progression>**
Enter the quality of progression for each movement of the current intersection.

ACTUATIONS **12*<Actuated Movement>**
Enter the type of phase module present, actuated or non-actuated, for each movement of the current intersection for use in the determination of the Delay Calibration Term (k).

REQCLEARANCES **12*<Required Clearance>**
Enter the clearance times required for each movement of the current intersection.

MINIMUMS **12*<Minimum Green Time>**
Enter the minimum green time requirements for each of the twelve movements of the current intersection.

STARTUPLOST **12*<Startup Lost Time>**
Enter the length of the lost time at the beginning of a movement's green period for each of the twelve movements of the current intersection.

ENDGAIN **12*<End Gain Time>**
Enter the length of time that vehicles effectively extend the green period into the yellow and all-red period for each of the twelve movements of the current intersection.

STORAGE **12*<Storage Distance>**
Enter the amount of storage distance for queued vehicles for each of the twelve movements of the current intersection.

INITIALQUEUE **12*<Initial Queue Size>**
Enter the number of vehicles queued at the intersection at the start of the analysis period for each of the twelve movements of the current intersection.

IDEALSATFLOWS **12*<Ideal Saturation Flow Rate>**
Enter the base (ideal) saturation flow rate for each movement of the current intersection.

FACTORS **12*<Satflow Adjustment Factor>**
Enter satflow adjustment factors for each movement of the current intersection to adjust 2000 *Highway Capacity Manual* satflow computations.

DELAYFACTORS **12*<Delay Adjustment Factor>**
Enter factors for each movement of the current intersection used to adjust the delay calculations, for example, to match delays obtained from a network simulation model.

NSTOPFACTORS **12*<Stops Adjustment Factor>**
Enter twelve factors used to adjust the number of stops calculations of the EVALUATE report of the current intersection, for example, to match the number of stops obtained from a network simulation model.

SATURATIONFLOWS **12*<Stream Saturation Flow>**
Store the results of saturation flow rate computations of the current intersection. When computational commands of the Analysis Mode like ANALYZE, EVALUATE, QUEUECALCS, GOVERCS and SERVICEVOLUMES are executed, the calculated saturation flows are dumped into this command.

Commands to Enter Phasing Data

The following are commands which can be used to describe the phasing at the current intersection. Some of these commands were also included in the Basic Data discussed above.

SEQUENCES **<Sequence Code> <List of Possible Sequence Codes>**

Enter the desired and allowed phasings of the traffic signal of the current intersection according to the codes defined in Figure 1-2 of Chapter 1.

PERMISSIVES **4*<Permissive Left>**
Enter an option for each approach of the current intersection identifying the permissability of left-turning traffic to turn on a through phase following or preceding an exclusive left turn phase (e.g. a protected-permitted left-turn or a permitted-protected left-turn, more recently referred to as compound left-turn phasing).

OVERLAPS **4*<Right Turn Overlap>**
Enter how right turn overlaps are to be handled for each approach of the current intersection.

LEADLAGS **2*<Lead-Lag Phasing>**
Enter the order of the phases, particularly in multiphase operation, of the current intersection.

CYCLES **<Minimum Cycle> <Maximum Cycle> <Cycle Increment>**
Enter the range and precision of cycle length scanning for the current intersection for DESIGN, as well as the default cycle length for the ANALYZE, EVALUATE, QUEUECALCS, SERVICEVOLUMES, GOVERCS and EXPORT commands.

GREENTIMES **6*<Phase Green Time>**
Enter the duration of green for each of the phases of a specified phase sequence, or optionally for each of the movements, of the current intersection.

YELLOWTIMES **6*<Phase Yellow Time>**
Enter the clearance interval at the end of each phase of a phase sequence, or optionally for each of the movements, of the current intersection.

CRITICALS **6*<Critical Movement Number>**
Enter the movement which is critical for each phase of the phase sequence of operation of the current intersection.

PEDTIME **<Exclusive Pedestrian Phase Time> <Phase Number>**
Enter the time for an exclusive pedestrian scramble phase of the current intersection.

OFFSET **<Offset> <Phase Number>**
Enter the coordinated offset for a phase of the phase sequence of the current intersection.

PHASEMOVEMENTS **<Phase Number> <List of Movements>**
Enter the movements permitted during each phase for a non-standard phasing of the current intersection.

Commands to Enter Traffic Generator Data

The following are commands which can be used to describe traffic generator data for each intersection being analyzed but whose data values are not used by SIGNAL2000. Their inclusion in the program is to provide seamless data file compatibility with the SITE program in particular, and all TEAPAC programs, in general.

SITESIZE **<# of Distribution Types> <# of Inbound Types>**
Enter the number of distribution types to be used to describe the inbound and outbound traffic generation.

ROUND **<Precision of Totals>**
Enter the precision to be used in computing the results.

BASE **<Generation Base> <X-Y Coord LL> <X-Y Coord UR>**
Enter the base development size for generating trips as it relates to the generation rates used for the development.

GENERATION **<Direction> <Generation Rate> 10*<Node-Dir>**
Enter the traffic generation rates and access points and access directions for the development.

PATHDISTRIBUTION **<Distr Type #> <Distr %> <Node #> <Node Dir> <Descr>**
Enter and set the current distribution type number, and enter its related distribution percentage, external node, and description.

PATHASSIGNMENT **<Path #> <Path %> <Path List>**
Enter a path (list of intersections) which vehicles of the current distribution type follow when traveling to and from the development.

ASSIGNMENT **<Type #> <Intersection #> 12*<<Movement #> <Assignment Factor>>**
Enter the percentage of a distribution type to be assigned to the movements at an intersection. This is only used to define special assignment situations, and is not normally used for typical site traffic assignment situations.

Commands to Enter Traffic Count Data

The following are commands which can be used to describe traffic count data for each intersection being analyzed but whose data values are not used by SIGNAL2000. Their inclusion in the program is to provide seamless data file compatibility with the TURNS and WARRANTS programs in particular, and all TEAPAC programs, in general.

COUNTTYPE **<Type of Data> <Type of Truck Counts>**

Enter the type of count data which is to be supplied to the program at the current intersection, and to provide a description of the count.

PERIODS **<Count Interval> 5*< <Start Time> <Stop Time> >**
Enter the count interval and the beginning and ending times for each count period for which subsequent data will be entered at the current intersection.

CONDITIONS **<Major Direction> <# N-S Lanes> <# E-W Lanes>**
<High Speed> <Low Population>
<Progression Impact> <Remedial Actions Failed>
<# Accidents for Signal> <Stop Sign Delay>
<# Accidents for Stop> <Minor Street Delay>
Enter intersection conditions which affect the conduct of a Warrant Analysis at the current intersection.

ADTFACTOR **<Factor to Expand Counts to 24 Hour Volumes>**
Enter a factor which will be used to estimate 24-hour volumes from partial day's counts at the current intersection.

VEHICLECOUNTS **<Movement or Time> <List of Counts>**
Enter the count of vehicles for a count interval or movement number at the current intersection.

TRUCKCOUNTS **<Movement or Time> <List of Counts>**
Enter the count of trucks for a count interval or movement number at the current intersection.

Common TEAPAC Dialogs

There are 22 command dialogs common to all TEAPAC programs. These commands control interactive functions, output labeling, program operation, permanent data storage and program execution. These common TEAPAC commands are summarized in this section. All the detail about these commands is found alphabetically in Appendix B of this manual with the other commands of the program discussed previously (as well as in Appendix B of all other TEAPAC program manuals).

Commands to Aid Interactive Input of Data
Commands to Label Output
Commands to Control Operation Of Program
Commands to Access Data Stored In Files
Commands to Control Program Execution

Commands to Aid Interactive Input of Data

The commands described below have functions related to the interactive use of the program. These commands control on-screen help functions as well as provide the means to review program data. Many of these commands act on a set of commands as their parameter values.

MESSAGES **<Level of Messages>**
Display messages concerning changes made to the program since the last printing of the tutorial/reference manual.

HELP **<List of Commands>**
Display the command names, parameter descriptions, and default values for each command listed.

ASK **<List of Commands>**
Produce a dialog box display for each of the listed commands.

RESET **<List of Commands>**
Reset the parameters of the specified commands to their default values.

DATA **<List of Commands>**
Display the current parameter values for the specified commands.

SUMMARISE **--**
Display a formatted summary of all [PARAMETERS] values. It has no parameters.

Commands to Label Output

The four commands described below control the report headings of the program. Report headings are used to identify the conditions of an analysis. Report headings are critical when multiple analyses are performed and documentation of various conditions analyzed is required.

PROJECT **<First Title Line>**
Enter the first line of information used to identify the situation being analyzed.

DESCRIPTION **<Second Title Line>**
Enter the second line of information used to identify the situation being analyzed.

NOTE **<Third Title Line>**
Enter the third line of information contained in the title of each report.

HEADING **<Number of Lines>**
Display the current title heading lines.

Commands to Control Operation of Program

The following commands control various aspects of program operation.

ECHO **<Input/Output Echo Condition>**
Enter the echo condition flag indicating whether or not command information should be displayed after being input from or output to a file.

IODEVICES **<Visual View> <Page #> <Lines/Pg> <Last Line #>**
Set the visual view style for dialogs, as well as the page number and the size of the output medium (i.e., paper).

NEWPAGE **<Page Advance Option>**
Enter a flag indicating that the next output report should begin with title headings at the top of the next page.

Commands to Access Data Stored In Files

The following commands are used when analysis data and/or commands are to be stored in permanent data files for later use.

FILES **5*<File Name>**
Enter the names of the permanent storage file areas where information is to be LOADed and SAVEd.

SAVE **<Line Number> <File Number> <List of Commands>**
Save the current parameter values of the listed commands in permanent storage locations specified by the FILES command, for future retrieval with the LOAD command.

LOAD **<Line Number> <File Number> <LOAD Type> <# Blocks>**
Input commands and parameters from permanent storage locations specified by the FILES command.

RETURN **--**
Return to the source of input which was being used when the last LOAD command was encountered. It has no parameters.

NEXTLINES **5*<Next Line of File>**
Enter the default next line to be accessed in each of the five files.

Commands to Control Program Execution

The following commands are used to direct program control. Typically, these commands are used within "control" files to execute a series of program steps.

STOP **<Next Program>**
Stop running the current program and optionally run a new program.

REPEAT **<Variable Name> <First Val> <Last Val> <Increment>**
Initiate a loop in a control file so that the set of commands which follow will be repeated a finite number of times.

GOTO **<Destination>**

Divert the input stream within a file by providing the next location to be LOADed from that file.

CALCULATE **<Algebraic Expression>**

Perform a calculation for the given expression and optionally assign the integer result to a user variable.

CHAPTER 5

Advanced Procedures

Chapter 5 Topics

Chapters 1 through 4 covered the basic methods and commands required to use the SIGNAL2000 program to solve most problems which will be encountered. The advanced procedures discussed in this chapter can greatly increase efficiency in solving problems with SIGNAL2000, as well as provide insights into how to use SIGNAL2000 to solve unusual problems. Before beginning this section, it is necessary to have a good understanding of the material covered in the previous chapters, as well as in the *TEAPAC Tutorial/ Reference Manual*. If this is not the case, please review this material prior to continuing. Chapter 5 of the *TEAPAC Tutorial/Reference Manual* can also be used to discover advanced procedures which can be used by SIGNAL2000, as well as all TEAPAC programs.

Chapter 5 Topics:

Multi-Leg Intersections

SIGNAL2000 can be used quite effectively to perform capacity analyses of multi-leg intersections, that is, intersections with more than four approach legs. These are typically, but not limited to, five and six leg intersections. SIGNAL2000 can also be used in an iterative fashion to optimize timings for multi-leg intersections. All of this is described below.

Capacity Analysis

The secret to using SIGNAL2000 for multi-leg intersection analysis is use of the PEDTIME command, which is normally used to define an all-red time for a pedestrian scramble phase. In this case, PEDTIME is used to hold time for the legs of the intersection which cannot be included in the analysis. To do this, the four primary legs of the intersection should be identified, which hopefully use a phasing which is similar to one of the standard phasings of SIGNAL2000. These legs should be entered into SIGNAL2000 as an intersection, using the normal data entry methods. The only difference is that a PEDTIME command should be used to define the period of time during the cycle when the other movements which are not included in the analysis receive a green indication. This time will be completely removed from the cycle and the capacity analysis of the entered movements will be correct. The remaining movements should then be entered into SIGNAL2000 as a separate intersection, again using PEDTIME to define the period of the cycle used by the movements of the first analysis. As before, these movements should be entered such that a standard SIGNAL2000 phasing can be used. In this entry process, at least one movement must exist for a North-South phase and one for an East-West phase, so a dummy movement with 1 vehicle per hour may need to be defined to meet this requirement, or legs of the previous analysis can be re-used.

Timing Optimization

If the above analysis can be conducted using a standard phasing code, then the DESIGN command can be used to optimize timings for the entire intersection, using a small bit of iterative analysis. If the cycle length to be used is known, a guess at the "pedtime" for each intersection part must be made and subsequently revised until the desired balance between the performance of each part is obtained. If the cycle length is not known in advance, this guesswork is a bit more complex since the PEDTIME entry is made in seconds and must be related to a percentage of the cycle length which is not yet know. In this case, simply guess also at the cycle length which might result before guessing at the "pedtime", and iterate. If the phasing cannot be represented by a standard sequence code, then use a similar sequence code so the GOVERCS command can be used to determine the G/C requirements for each movement at each level of service. Then the GREENTIMES used can be assigned manually to phases of SEQUENCE 0 using these results as a guide.

Dual-Optional Turn Lane Analysis

When a shared lane allows turns which also move in an adjacent exclusive turn lane, computation of saturation flow and delay is not explicitly covered by the 2000 *Highway Capacity Manual*, in that the number of turns in the shared lane must be determined. Use of the DUALOPTIONAL option of the GROUPTYPES command provides an automated solution to this problem in an approximate manner by computing the turns in the shared lane in a manner that approximately balances the v/c ratios in the affected lane groups (without also exceeding the designated lane utilization inputs). Frequently this solution is adequate. The following is a method which allows more complete analysis of this condition, if desired.

The basic method is to determine what turning volume is likely to turn from the shared lane, and to adjust the saturation flow rate computations to reflect this number. The analysis proceeds specifying to SIGNAL2000 a single exclusive turn lane and the through lane not being shared with this turn lane. A phasing and G/C estimates are also entered. The GOVERCS command is then used to determine how much G/C is required by the two adjacent lane groups, the exclusive turn lane and the through lane group. By comparing these G/C requirements at the level of service expected to be experienced, the number of turning vehicles operating from the through lane group can be deduced. This is then accounted for by using the FACTORS command for the two lane groups to increase the capacity of the single exclusive turn lane (to effectively account for the additional capacity gained from turners in the through lane group) and to decrease the capacity of the through lane group. The following formulas can be used to determine these factors.

$$F_{trn} = K / G_{th}$$

$$F_{th} = K / G_{trn}$$

$$K = \frac{(V_{th} * G_{trn}) + (V_{trn} * G_{th})}{V_{th} + V_{trn}}$$

where:

- F_{trn} = factor to apply to calculation of turning lane saturation flow rate
- F_{th} = factor to apply to calculation of through lane group saturation flow rate
- K = constant for calculations
- G_{trn} = G/C required for turning lane at target level of service, determined from GOVERCS command
- G_{th} = G/C required for through lane group at target level of service, determined from GOVERCS command
- V_{trn} = demand volume for turning lane group
- V_{th} = demand volume for through lane group

If F_{trn} is calculated as less than 1.00, no use of the through lanes will be made by the turning vehicles and the analysis should not be modified any further. Consideration of removing the dual-optional lane usage of an existing condition should be considered if this is the case.

If F_{trn} is calculated as more than about 1.80, the analysis should be re-specified as an exclusive dual turning lane and one less lane in the through lane group, since the added capacity effect of the shared turn-through lane clearly cannot exceed 2.00 -- this would be roughly the same as having exclusive dual turning lanes.

Note that when a dual-optional lane group is operated, it must be limited to a phasing that only allows both the turning traffic and the through traffic to operate together during a single phase indication. This is usually a split-phase operation, sequence type 7.

After the FACTORS are applied, the analysis should be checked to observe roughly the same amount of delay to both the single turn lane group and the adjacent through lane group. Furthermore, to be precise about the analysis, if the level of service of these two lane groups and/or the initial G/C estimates are not the same as assumed when using the G/C values from the GOVERCS command, new FACTORS should be calculated using the new expected level of service G/C values and the process should be iterated until all the results are in agreement with the initial assumptions. This normally requires at least one additional set of computations.

Sharing Data Files with Other TEAPAC Programs

A major element in the design of TEAPAC programs is the ability to share both input and output data amongst any TEAPAC programs which can make valid use of the data. All TEAPAC application programs (except NOSTOP) use the same single data file which contains all data entries used by all programs. This includes intersection traffic and geometric data, network data, traffic count data and traffic generator data, whether or not this data is specifically germaine to the purpose of the specific program being used at the time. This means that all of this data can be shared amongst all TEAPAC programs by simply opening the one data file into the program desired, and saving the data, as appropriate, before moving to another program. The easiest way to accomplish this is by using the LinkTo menu which automatically closes the current program and opens the selected program with the same data file.

In the case where data changes within one program as a result of an analysis and these changes are needed for use in another program, the user need only save the changes in the file before opening the file in the next program. The LinkTo menu provides a simple way to transfer control of the file to that next program (after the save function) by simply selecting the next program. Examples of circumstances where this exchange of results might occur are illustrated below:

In SIGNAL2000

- Computed HCM-compliant SATURATIONFLOWS can be transferred to TEAPAC PREprocessors for use by PASSER, TRANSYT, CORSIM, SYNCHRO or TSPPD.
- HCM-optimized SEQUENCES, GREENTIMES and YELLOWTIMES can be transferred to TEAPAC PREprocessors for use by NOSTOP, PASSER, TRANSYT, CORSIM, SYNCHRO or TSPPD for various forms of coordinated operation assessment and/or optimization.

In PREprocessors

- Imported optimized OFFSETS (and possibly GREENTIMES) can be transferred to SIGNAL2000 or other TEAPAC PREprocessors for evaluation, graphical rendition, simulation, animation or further optimization.

In TURNS/WARRANTS

- Peak 15-minute or 60-minute VOLUMES (and possibly TRUCKPERCENTS and PEAKHOURFACTORS) can be transferred to SIGNAL2000 for HCM-compliant capacity analysis, HCM phasing/timing optimization or intersection design.

- Peak 15-minute or 60-minute VOLUMES (and possibly TRUCKPERCENTS and PEAKHOURFACTORS) can be transferred to TEAPAC PREprocessors for use by PASSER, TRANSYT, CORSIM, SYNCHRO or TSPPD.
- Peak 15-minute or 60-minute VOLUMES can be transferred to SITE as background traffic for traffic impact analysis studies.

In SITE

- Projected added volumes (VOLADDITIONALS) can be transferred to SIGNAL2000 for HCM-compliant capacity analysis, HCM phasing/timing optimization or intersection design.
- Projected added volumes (VOLADDITIONALS) can be transferred to TEAPAC PREprocessors for use by PASSER, TRANSYT, CORSIM, SYNCHRO or TSPPD.

Traffic volumes are an important element either determined by or used by virtually all modules of TEAPAC, thus a discussion here of how volume information flows among all the TEAPAC programs will be helpful. Analysis volumes in any TEAPAC program are the additive combination of VOLUMES and VOLADDITIONALS entries. Thus, for any given movement, the VOLUMES entry for that movement is added to the VOLADDITIONALS entry for that movement to arrive at the analysis volume for that movement. For added flexibility, VOLUMES entries can be factored up or down by corresponding VOLFACTORS entries (with the additional possibility of compounded growth applied to those factors) and VOLADDITONALS entries can be factored up or down by a separate factor. Normally, VOLUMES will be either entered by the user or set automatically by peak period analysis in TURNS or WARRANTS (consistent with the then-current VOLFACTORS entries). Normally, VOLADDITIONALS will be either entered by the user or set automatically by traffic generation computations in SITE (consistent with the then-current VOLUMES and VOLFACTORS entries). The user is directed to the specific formulas for analysis volume determination described in detail in Appendix C.

The following discussion provides further program-specific notes about data file sharing for this program.

Input Data from TURNS, WARRANTS and SITE

SIGNAL2000 can provide capacity analyses and timing/phasing optimizations for traffic volumes which are either tabulated from traffic counts by TURNS or WARRANTS, or estimated from a traffic planning effort (such as a traffic impact study) by SITE.

For existing conditions, TURNS (and WARRANTS) can provide useful results for SIGNAL2000. After the turning movement count summaries and peak-period analyses of TURNS are completed, the peak-period VOLUMES entries which are created are normally used as existing traffic volumes for the initial capacity analyses with SIGNAL2000. The VOLUMES results of the TURNS peak-period analyses can be saved directly to the data file which can then

be read by SIGNAL2000 for these purposes. Note also that these VOLUMES can be easily factored by using the individual VOLFACTORS entries, as well as the global entry of VOLFACTORS when intersection 0 (all intersections) is selected.

For planning analyses of projected volumes, the SITE program can be used in exactly the same manner as TURNS, creating a set of projected VOLADDITIONALS in the file, allowing a duplicate analysis to be performed on projected volumes, as well as existing volumes. With the DESIGN feature of SIGNAL2000, this allows immediate optimization of projected conditions, making SIGNAL2000 a perfect tool for applying the 2000 *Highway Capacity Manual* operations method to planning analyses without the need for the more approximate planning method of the 2000 *Highway Capacity Manual*. This optimization can also be used to quickly assess the value of various improvement alternatives for an impact study. Note also that these VOLADDITIONALS can be easily factored by using the individual VOLADDITIONALS factor entry, as well as the global entry of the factor when intersection 0 (all intersections) is selected. Another use of the factor, including its global entry, is to disable the VOLADDITIONALS by using a factor of 0.

Using SIGNAL2000 Data for PREPASSR, PRETRANSYT, PRENETSIM, PRESYNCHRO, PRETSPPD and PRENOSTOP

SIGNAL2000 can provide a number of relevant analyses for typical arterial and network signal timing studies with PASSER, TRANSYT, NETSIM/CORSIM, SYNCHRO/SIMTRAFFIC, TS-PP/DRAFT and NOSTOP. For existing conditions, SIGNAL2000 can provide a complete and comprehensive capacity analysis (including computation of saturation flow rates) strictly according to the methods of the 2000 *Highway Capacity Manual*. When optimizing the signal timings of each signal in an arterial, SIGNAL2000 will consider virtually every possible phasing combination, for both the major street and the cross street, and will completely consider the effects which right turns, clearance intervals, minimums and movement priorities have on the best timings. These optimized conditions can be SAVEd with SIGNAL2000, and then PREPASSR, PRETRANSYT, PRENETSIM, PRESYNCHRO, PRETSPPD or PRENOSTOP can be run using all of these results without any re-entry. This virtually eliminates any input at all to these programs, using all of the data already entered and optimized from SIGNAL2000.

In order to accomplish this, each individual intersection is described and SAVEd in detail with SIGNAL2000, prior to any preprocessor use. This description will include the INTERSECTION, NETWORK, VOLUMES, WIDTHS, etc. inputs which are subsequently needed by the preprocessors. If optimized intersection results are to be used by the preprocessors, these results should also be SAVEd after they are computed. Also, if SIGNAL2000's SATURATIONFLOWS are to be used by the preprocessors, they should be SAVEd with SIGNAL2000 after they are computed, such as after using the ANALYZE or SERVICEVOLUMES commands. These are typically SAVEd along with the optimized signal timings and phasings. The SAVEd SIGNAL2000 file can be opened directly by the TEAPAC preprocessor and used accordingly. The easiest way to accomplish this is by using the LinkTo menu which automatically closes the SIGNAL2000 program and opens the selected preprocessor with the same data file.

Analysis Period and the Use of PEAKHOURFACTORS

Peak hour factors (PHF) are applied to the input demand volume to determine the "adjusted volume" for use in the saturation flow, v/c, and delay calculations. This adjusted volume is, in fact, an estimate of the flow rate of each movement during the peak 15-minute period for the intersection, since this is the base analysis period which the 2000 HCM expects the user to analyze. A much better procedure is to determine the peak 15-minute period for the intersection from the count data and simply use the 15-minute flow rates during this period in combination with a PHF of 1.0 for each movement. The 15-minute flow rates are simply the peak 15-minute counts multiplied by 4.

If the actual peak 15-minute flow rates are not used, caution should be exercised in calculating peak hour factors from traffic counts, particularly on a movement-by-movement basis, since this calculation may not be statistically stable, especially for low volume movements. Furthermore, if the PHF is determined for each movement, it is most likely that all of these peaks for each movement do not occur at the same time, thus their application in computing "adjusted volumes" for each movement will result in a volume condition which never exists, but instead represents the highest 15-minute flow rate for each movement lumped together into a single hypothetical 15-minute period. A better alternative to using the peak 15-minute flow rates would be to use the intersection PHF for each movement, or at worst, calculate a PHF for each approach and use this value for all movements on that approach.

Using ACTUATIONS and MINIMUMS

An area that deserves special consideration is when optimizing timings for actuated signals. It is important to recognize that the 2000 HCM analysis is a fixed-time representation of the actuated controller, so the optimization represents the average phase time which should occur over the course of the analysis period. It is quite possible for low volume movements which are not actuated every cycle that the average phase length is considerably less than the normal MINIMUM which is desired for each cycle the movement is actuated. Thus for design purposes, the MINIMUMS entry for actuated movements could be a small number less than the normal MINIMUMS entry. An entry value of 1.0 is recommended for most cases.

Field Calibration of Adjusted SATURATIONFLOWS with FACTORS

The FACTORS command of SIGNAL2000 provides a simple way of performing field calibration on a sample of lane groups and then extrapolating this sample for all lane groups of an analysis. The key to this process is recognizing that a survey of saturation flow rate in the field is a survey of adjusted satflows rather than ideal satflows. The SIGNAL2000 method is to survey the adjusted satflow in the field and then use the normal HCM procedures in SIGNAL2000 to estimate the same adjusted satflow. The ratio of the two values will create a FACTORS entry which can be used for all similar lane groups which are not surveyed, and which will succinctly represent the adjustment which has been made to calibrate the HCM procedures to local conditions.

Proper Use of RIGHTTURNONREDS

The prescribed technique in the 2000 HCM for treating right turns on red (RTOR) is to subtract these vehicles from the demand volume before continuing the analysis, with a limitation that except when "shadowed" by a protected left turn phase, RTOR should not be used unless an actual RTOR volume has been counted. The assertion that RTOR should be removed from the analysis suggests that these vehicles have no delay of their own, nor do they cause any delay for other vehicles, neither of which is true. Although RTOR has a beneficial effect on traffic flow, this model of these benefits is wholly inadequate and inappropriate. In light of this limitation, we suggest RTOR volumes be used only with great caution in an HCM analysis.

APPENDICES

Reference Manual

The following appendices form the SIGNAL2000 Reference Manual. This manual is designed to provide detailed information regarding various aspects of the SIGNAL2000 program. The information in the appendices is ordered such that easy reference access is possible. Each of the appendices is described briefly below.

Appendix A
ABBREVIATED DESCRIPTION OF ACTIONS AND ENTRIES

Appendix A lists all SIGNAL2000 commands by group name. This appendix is designed for quick reference regarding group names and command hierarchy. The single line descriptions are identical to the descriptions provided by the Help-Commands menu and the HELP command. The descriptions identify the names and number of parameter values along with any default values.

Appendix B
DETAILED DESCRIPTION OF ACTIONS AND ENTRIES

Appendix B provides complete detail regarding the SIGNAL2000 commands and their associated parameter values. All SIGNAL2000 commands are listed in this section. Five categories of information are provided for each command: 1) Format, 2) Function, 3) Parameters, 4) Group Names and 5) Notes. This appendix provides specific details on how to use a SIGNAL2000 command and what, if any, limitations exist on the associated parameter values. The Note category provides useful "hints" on the use of the command.

Appendix C
ANALYSIS METHODS AND FORMULATIONS

Appendix C discusses the methods and formulae used by the SIGNAL2000 program to calculate results. Using the procedures discussed in this appendix, it is possible to manually recreate the results calculated by SIGNAL2000.

Appendix D
REPORT DESCRIPTIONS AND EXAMPLES

Appendix D describes the reports generated by the SIGNAL2000 program. In addition, sample output is provided for each type of report generated by the SIGNAL2000 program. The elements of each report are described in detail.

Appendix E
ERROR MESSAGES AND TROUBLE SPOTS

Appendix E describes program specific error messages of the SIGNAL2000 program, the potential cause of such errors and potential solutions. SIGNAL2000 errors are identified by the letters "S2K" followed by a two-digit number. In addition, potential trouble spots associated with using the SIGNAL2000 program are outlined. This appendix is useful for identifying program-specific causes for certain problems in the use of SIGNAL2000, as well as preventing future errors.

Appendix F
TEAPAC SYSTEM ERROR MESSAGES

Appendix F describes error messages which are common to all TEAPAC programs. TEAPAC error or warning messages are identified by the letters "TPC" followed by a two digit number. This appendix discusses each TEAPAC error and potential causes and solutions. Appendix F of each TEAPAC Manual is identical for quick reference purposes.

Appendix G
OPERATING SYSTEM MESSAGES AND INSTALLATION NOTES

Appendix G discusses the unique aspects of the installation of TEAPAC programs on a particular operating system. Operating system dependent functions such as error messages, file specification procedures and output control features are discussed. Special function keys, such as control characters, are also discussed. Appendix G of each TEAPAC Manual is identical for quick reference purposes.

Appendix H
ADDENDA

Appendix H provides a location for recent release notes and addenda which may be published after the official release of this documentation. This appendix can also be used to store printed copies of new release notes for updated versions of SIGNAL2000, as produced by the Help-RecentChanges menu or the MESSAGES command, for off-line reference.

APPENDIX A

Abbreviated Description of Actions and Entries

Appendix A Topics

Appendix A is designed as a quick reference to the SIGNAL2000 commands and their associated parameter values. This appendix is also useful for identifying what specific Group Names exist in the SIGNAL2000 program (Table A-1), which commands can be found in each group (Table A-2), and an alphabetical list of commands (Table A-3). The command information contained in this appendix can be accessed interactively using the HELP command.

In Table A-1, the column labeled "Std Name" has an "X" entered for every group name that is a standard name found in each TEAPAC program. The name and meaning of these groups in each TEAPAC program is identical, allowing a quick understanding of how commands are organized in each TEAPAC program. The column labeled "Std Group" has an "X" entered for every group which is comprised of standard TEAPAC commands. In these cases, not only is the name of the group the same in every TEAPAC program, but the names and purposes of the commands in the groups are also identical among TEAPAC programs, further enhancing the quick understanding of commands in each TEAPAC program.

Group names are useful when using a command which requires a list of commands as a parameter value. These are the RESET, ASK, DATA, HELP and SAVE commands. Group names make it possible to list a complete set of commands using a single parameter value. In order to use a group name as a parameter value, it is necessary to enclose the group name in square brackets, "[XXX]", as shown in this appendix.

Table A-1
Group Name Structure

[GROUP NAME] - Types of Commands Included in Group	Std Name	Std Group
[ALL] - All of the SIGNAL2000 commands, alphabetically	X	
[INFO] - help & information about updates	X	X
[DATAFILES] - data and file management	X	X
[TITLES] - enter the headings for report output	X	X
[CONTROL] - control program execution environment	X	X
[RESULTS] - perform program-specific actions	X	
[PARAMETERS] - enter program-specific data	X	
[BASIC] - enter essential data requirements	X	
[SYSTEM] - enter network-wide system data		
[INTERSECTION] - enter intersection data		
[APPROACH] - enter approach-specific data		
[MOVEMENT] - enter movement-specific data		
[PHASING] - enter phasing and timing data		
[TURNS/WARRANTS] - enter traffic count data		
[SITE] - enter traffic generator data		
[94DEFAULTS] - reset new defaults for 94 HCM		
[ANALYZE] - related to capacity analysis actions		
[DESIGN] - related to design optimization actions		

Appendix A Topics:

Appendix A Introduction
SIGNAL2000 Command Structure
All Commands

SIGNAL2000 Command Structure

Each SIGNAL2000 command has been classified into one or more "groups", each of which consist of a subset of all SIGNAL2000 commands. Each group contains commands which share functional similarities. The Group Name associated with each group describes the function

shared by the commands. The Group Names form a heirarchical command structure, as outlined in Table A-1. Group names are either common names used in all TEAPAC programs, or special names used by the SIGNAL2000 program, as described in the following sections.

Table A-2 provides a cross-reference between each of the commands and the group names. Abbreviated group names appear across the top of the table and commands along the left side. An "X" in the table indicates that the command to the left is included in the group name above. This table allows a quick view of the relationship between group names and commands.

Common TEAPAC Group Names
Special SIGNAL2000 Group Names

Table A-2
<u>Cross-Reference of Commands and Groups</u>

Command	ALL	INF	DAT	TIT	CON	RES	PAR	BAS	SYS	INT	APR	MOV	PHA	TUR	SIT	94D	ANA	DES
MESSAGES	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
HELP	X	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
RESET	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
DATA	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SUMMARISE	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
FILES	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NEXTLINES	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ECHO	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
LOAD	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SAVE	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ASK	X	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
PROJECT	X	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
DESCRIPTION	X	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
NOTE	X	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.
STOP	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
IODEVICES	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
NEWPAGE	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
HEADING	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
CALCULATE	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
REPEAT	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
GOTO	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
RETURN	X	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.
DESIGN	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	X
SORT	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	X
TIMINGS	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	X
ANALYZE	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	X
EVALUATE	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	X
QUEUECALCS	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	X
EXPORT	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	X
GOVERCS	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	X
SERVICEVOLUMES	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	.
DIAGRAMS	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	.
MAP	X	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	.
NODELIST	X	.	.	.	.	.	X	X	X	.	.	.	.	.	.	.	.	.
SUBSYSTEM	X	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.
ROUTE	X	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.
MASTERNODE	X	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.
QUEUEMODELS	X	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.
SIMULATION	X	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.
OPTIMIZE	X	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	.	.
OUTPUT	X	.	.	.	.	.	X	.	X	.	.	.	.	.	.	.	X	X
INTERSECTION	X	.	.	.	.	.	X	X	.	X	.	.	.	.	.	.	.	.
NODELOCATION	X	.	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.	.
METROAREA	X	.	.	.	.	.	X	X	.	X	.	.	.	.	.	.	.	.
NETWORK	X	.	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.	.
LEVELOFSERVICE	X	.	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.	X
EXCESS	X	.	.	.	.	.	X	.	.	X	.	.	.	.	.	.	.	X

Table A-2 (continued)
Cross-Reference of Commands and Groups

Command	Groups: ALL	INF	DAT	TIT	CON	RES	PAR	BAS	SYS	INT	APR	MOV	PHA	TUR	SIT	94D	ANA	DES
APPLABELS	X	.	.	.	.	.	X	X	.	.	X	.	.	.	.	.	.	.
GRADES	X	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.
PEDLEVELS	X	.	.	.	.	.	X	.	.	.	X	.	.	.	.	X	.	.
BIKEVOLUMES	X	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.
PARKINGSIDES	X	.	.	.	.	.	X	X	.	.	.	.	.	.	.	.	.	.
PARKVOLUMES	X	.	.	.	.	.	X	X	.	.	X	.	.	.	.	.	.	.
BUSVOLUMES	X	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.
RIGHTTURNONREDS	X	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.
UPSTREAMVC	X	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.
MOVLABELS	X	.	.	.	.	.	X	X	.	.	.	X	.	.	.	.	.	.
VOLUMES	X	.	.	.	.	.	X	X	.	.	.	X	.	.	.	.	.	.
VOLFACTORS	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
VOLADDITIONALS	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
WIDTHS	X	.	.	.	.	.	X	X	.	.	.	X	.	.	.	.	.	.
LANES	X	.	.	.	.	.	X	X	.	.	.	X	.	.	.	.	.	.
GROUPTYPES	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
UTILIZATIONS	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	X	.	.
TRUCKPERCENTS	X	.	.	.	.	.	X	X	.	.	.	X	.	.	.	.	.	.
PEAKHOURFACTORS	X	.	.	.	.	.	X	X	.	.	.	X	.	.	.	.	.	.
ARRIVALTYPES	X	.	.	.	.	.	X	X	.	.	.	X	.	.	.	X	.	.
ACTUATIONS	X	.	.	.	.	.	X	X	.	.	.	X	.	.	.	.	.	.
REQCLEARANCES	X	.	.	.	.	.	X	X	.	.	.	X	.	.	.	X	.	X
MINIMUMS	X	.	.	.	.	.	X	X	.	.	.	X	.	.	.	.	.	X
STARTUPLOST	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
ENDGAIN	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
STORAGE	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
INITIALQUEUE	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
IDEALSATFLOWS	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	X	.	.
FACTORS	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
DELAYFACTORS	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
NSTOPFACTORS	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
SATURATIONFLOWS	X	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	.	.
SEQUENCES	X	.	.	.	.	.	X	X	.	.	.	.	X	.	.	.	X	X
PERMISSIVES	X	.	.	.	.	.	X	.	.	.	.	.	X	.	.	.	.	.
OVERLAPS	X	.	.	.	.	.	X	.	.	.	.	.	X	.	.	.	.	.
LEADLAGS	X	.	.	.	.	.	X	.	.	.	.	.	X	.	.	.	.	.
CYCLES	X	.	.	.	.	.	X	X	.	.	.	.	X	.	.	.	X	X
GREENTIMES	X	.	.	.	.	.	X	X	.	.	.	.	X	.	.	.	X	.
YELLOWTIMES	X	.	.	.	.	.	X	X	.	.	.	.	X	.	.	.	X	.
CRITICALS	X	.	.	.	.	.	X	.	.	.	.	.	X	.	.	.	X	.
PEDTIME	X	.	.	.	.	.	X	.	.	.	.	.	X	.	.	.	.	.
OFFSET	X	.	.	.	.	.	X	.	.	.	.	.	X	.	.	.	.	.
PHASEMOVEMENTS	X	.	.	.	.	.	X	.	.	.	.	.	X	.	.	.	.	.

Table A-2 (continued)
Cross-Reference of Command and Groups

Command	ALL	INF	DAT	TIT	CON	RES	PAR	BAS	SYS	INT	APR	MOV	PHA	TUR	SIT	94D	ANA	DES
COUNTTYPE	X	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	.
PERIODS	X	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	.
CONDITIONS	X	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	.
ADTFACTOR	X	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	.
VEHICLECOUNTS	X	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	.
TRUCKCOUNTS	X	.	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	.
SITESIZE	X	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.
ROUND	X	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.
BASE	X	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.
GENERATION	X	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.
PATHDISTRIBUTION	X	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.
PATHASSIGNMENT	X	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.
ASSIGNMENT	X	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.

Common TEAPAC Group Names

The group name [ALL] contains every possible SIGNAL2000 command. This group is organized in alphabetical order. The [ALL] group is divided into six sub-groups, all of which have standard group names used in every TEAPAC program. These are [INFO], [DATAFILES], [TITLES], [CONTROL], [RESULTS], and [PARAMETERS]. The first four encompass the 22 standard TEAPAC commands found in every TEAPAC program. These are used primarily for the basic housekeeping chores needed for program manipulation, such as on-screen help, data manipulation, file handling, output labeling, printer control, and control file actions. The last two sub-groups contain commands specific to the SIGNAL2000 program. The first, [RESULTS], consists of active commands which produce specific SIGNAL2000 results. The other, [PARAMETERS], consists of all of the commands which can be used to enter the data values which describe the scenarios to be analyzed by the [RESULTS] commands.

The [PARAMETERS] group has another standard TEAPAC group name as its sub-set. This is the [BASIC] group, which consists of those important and necessary [PARAMETERS] commands needed as a minimum to describe the data for an analysis. In the SIGNAL2000 program, since the [PARAMETERS] group is quite large, it is further sub-divided into additional special groups as described below.

Special SIGNAL2000 Group Names

The SIGNAL2000 program contains ten special group names, eight of which are subsets of the [PARAMETERS] group. The subset groups are [SYSTEM], [INTERSECTION], [APPROACH], [MOVEMENT], [PHASING], [TURNS/WARRANTS], [SITE] and [94DEFAULTS]. The [INTERSECTION] commands are used to input those parameters which affect the entire intersection, such as metropolitan area. The [APPROACH] commands are used to enter those parameters specific to each of the four approaches. The [MOVEMENT]

commands are used to enter data specific to each of the twelve movements. The [PHASING] commands describe the signal phasing and timing parameters. The [TURNS/WARRANTS] and [SITE] commands are used to enter those parameters which are needed only by TURNS, WARRANTS and SITE -- these are present for seamless data file compatibility with these programs using the LinkTo menu. The [94DEFAULTS] commands are used to reset certain commands to their 1994/1997/2000 HCM default values after loading data from a SIGNAL85 data file.

The remaining special group names, [ANALYZE] and [DESIGN], consist of the commands which are used most frequently when performing iterative ANALYZE and DESIGN commands, respectively. The [ANALYZE] commands include parameters such as the green and yellow times while the [DESIGN] commands control the levels of service and cycle lengths to be tested. These special group names are best used with the ASK command from the Manual Mode to generate helpful sequences of command dialogs for the activities described above.

All Commands

Table A-3
All Commands Listed Alphabetically

Command	Parameter Values	Defaults
ACTUATIONS	12*<Actuated Mov't NO/YES or Extension (sec)>	12*NO
ADTFACTOR	<Factor to Expand Counts to 24 Hour Volumes>	0.0
ANALYZE	-	-
APPLABELS	4*<1-character Approach Label>	N,E,S,W
ARRIVALTYPES	12*<Arrival Type - 1/2/3/4/5/6; PVG; or RP>	12*3
ASK	<List of Commands>	[PARAM]
ASSIGNMENT	<Type#> <Int#> 12*<<Mov#> <Asgn Fctr (%)>>	- - - 12*0
BASE	<Dev Size> <LL X,Y Coord> <UR X,Y Coord>	0 0 0 0 0
BIKEVOLUMES	4*<Conflicting Bicycles (bikes/hr)>	4*0
BUSVOLUMES	4*<Stopping Bus Volume (bus/hr)>	4*0
CALCULATE	<Algebraic Expression>	-
CONDITIONS	<MjDr> <LnNS> <LnEW> <SPD> <POP> <PRG> <REM> 2*<<Acc> <Dly>>	
COUNTTYPE	<Count Type - CUM/RED> <Truck Type - INC/SEP>	RED INC
CRITICALS	6*<Critical Movement Number>	6*0
CYCLES	<Min Cycle (s)> <Max Cycle (s)> <Increment>	60 120 30
DATA	<List of Commands>	[PARAM]
DELAYFACTORS	12*<Delay Adjustment Factor>	12*1.00
DESCRIPTION	<Second Title Line>	blanks
DESIGN	<# of Sequences to Analyze after DESIGN>	1
DIAGRAMS	<Sequence Code>	-1
ECHO	<Input/Output Echo Condition - NO/YES>	NO
ENDGAIN	12*<End Gain Time (sec)>	12*2.0
EVALUATE	-	-
EXCESS	<List of Priority Movement #'s>	0
EXPORT	AUTO/<File Name>	AUTO
FACTORS	12*<Capacity Adjustment Factor>	12*1.00
FILES	5*<File Name>	5*blanks
GENERATION	<IN/OUT/BOTH> <Gen Rate> 10*<Node-Dir>	- 0.0 10*(0-)
GOTO	<Line #>/<Repeat Variable>	next
GOVERCS	-	-
GRADES	4*<Grade of Approach (%)>	4*0.0
GREENTIMES	<Meth> 8*<Phase Green Time (sec or sec/sec)>	P 8*0.0
GROUPTYPES	12*<Lane Group - NORM/FREEFL/DUALOPT/STP/YLD>	12*NORMAL
HEADING	<Number of Lines>	3
HELP	<List of Commands>	[PARAM]
IDEALSATFLOWS	12*<Ideal Saturation Flow Rate (pcphgpl)>	12*1900
INITIALQUEUE	12*<Initial Queue (veh)>	12*0
INTERSECTION	<Node #> <Intersection Description>	0 BLANKS
IODEVICES	<View-NORM/TABL> <Page #> <Lin/Pag> <Lst Lin>	Norm 0 66 63
LANES	12*<Number of Lanes>	12*0
LEADLAGS	2*<Lead-Lag Phasing - NONE/LEAD/LAG>	2*NONE
LEVELOFSERVICE	<Delay1> <Delay2> <Delay3> <vc1> <vc2> <vc3>	C E 5 90 100 5
LOAD	<Line #> <File #> <PROCESS/SHARE/IGNORE> <#>	next next P 1

Table A-3 (continued)
All Commands Listed Alphabetically

Command	Parameter Values	Defaults
MAP	-	-
MASTERNODE	<Master Node #>	0
MESSAGES	<Level - 0/1/2/3>	3
METROAREA	<Location - CBD/NON-CBD>	NON-CBD
MINIMUMS	12*<Minimum Green Time (sec)>	12*5.0
MOVLABELS	12*<2-character Movement Label>	RT,TH,LT
NETWORK	N/E/S/W <Dst> <Spd> <Node> 4*<Mov> <Asgn> <Crv>	- 0 0 0 4*0 D N
NEWPAGE	<Page Advance - NO/YES>	YES
NEXTLINES	5*<Next Line of File>	5*0
NODELIST	500*<Node # in Optimization Order>	500*0
NODELOCATION	<X Coordinate> <Y Coordinate>	0 0
NOTE	<Third Title Line>	blanks
NSTOPFACTORS	12*<Stops Adjustment Factor>	12*1.00
OFFSET	<Phase Offset (sec or sec/sec)> <Phase #>	0.0 1
OPTIMIZE	NONE/OFFSTS/SPLTS+OFFS/CYCLE/LIST 15*<Steps>	NONE 15*0
OUTPUT	<Prog> <Worksheets> <Msgs> <Design/Eval>	S2K NO YES NO
OVERLAPS	4*<Rt Turn Overlap - NO/YES>	4*YES
PARKINGSIDES	4*<Location - NONE/RIGHT/LEFT/BOTH>	4*NONE
PARKVOLUMES	4*<Parking Volume (manuv/hr)>	4*20
PATHASSIGNMENT	<Path # (1-5)> <Asg %> <Node List - 16 max>	- - -
PATHDISTRIBUTION	<Typ #> <Distr %> <Node #> <Dir-N/E/S/W> <Desc>	- 0 0 - -
PEAKHOURFACTORS	12*<Peak Hour Factor>	12*0.90
PEDLEVELS	4*<Pedestrian Interference (ped/hr)>	4*0
PEDTIME	<Exclusive Ped-phase Time (sec)> <Phase #>	0.0 0
PERIODS	<Count Interval> 5*<<Start Time> <Stop Time>>	15 - -
PERMISSIVES	4*<Permissive Left - NO/YES>	4*NO
PHASEMOVEMENTS	<Phase #> <List of Movements>	0 0
PROJECT	<First Title Line>	blanks
QUEUECALCS	-	-
QUEUEMODELS	<Model #> <Percentile> <Auto (ft)> <Trk (ft)>	1 90 25 40
REPEAT	<Variable> <Start> <End> <Increment>	- 1 1 1
REQCLEARANCES	12*<Required Clearance (sec)>	12*4.0
RESET	<List of Commands>	[PARAM]
RETURN	-	-
RIGHTTURNONREDS	4*<Right Turn on Red Volume (vph)>	4*0
ROUND	<Precision of Totals (Veh)>	1
ROUTE	<Route #> <List of Node #s>	- 25*0
SATURATIONFLOWS	12*<Lane Group Saturation Flow (vphg)>	12*0
SAVE	<Line #> <File #> <List of Commands>	nxt nxt [P]
SEQUENCES	<Phasing Code> <List of All possible Codes>	11 ALL
SERVICEVOLUMES	-	-
SIMULATION	<Stps/Cyc> <Mins> <StpPn> <Links> <Act> <Asgn>	300 15 -1 T N F
SITESIZE	<# Distribution Types> <# Inbound Types>	0 0
SORT	<Priority - CYCLES/GOVERCS> <Output - NO/YES>	GCS YES

Table A-3 (continued)
All Commands Listed Alphabetically

Command	Parameter Values	Defaults
STARTUPLOST	12*<Startup Lost Time (sec)>	12*2.0
STOP	<Program Name>	-
STORAGE	12*<Storage Distance (feet)>	12*0
SUBSYSTEM	500*<Node # of Subsystem>	500*0
SUMMARISE	-	-
TIMINGS	<Seq Code> <Output - NONE/TIMINGS/DIAGRAM>	-1 TIMINGS
TRUCKCOUNTS	<Movement #>/<Time> <List of Counts>	0
TRUCKPERCENTS	12*<Truck-Thru Bus Percentage (%)>	12*2.0
UPSTREAMVC	4*<Upstream v/c Ratio>	4*0.0
UTILIZATIONS	12*<Lane Utilization Factor>	12*0.0
VEHICLECOUNTS	<Movement #>/<Time> <List of Counts>	0
VOLADDITIONALS	<Factor> 12*<Additional Volume>	1.0 12*0
VOLFACTORS	<# Years> 12*<Count Adjustment Factor>	1 12*1.00
VOLUMES	12*<Design Hour Volume (veh/hr)>	12*0
WIDTHS	12*<Lane Group Width (ft)>	12*0.0
YELLOWTIMES	<Meth> 8*<Phase Yellow Time (sec or sec/sec)>	P 8*0.0

APPENDIX B

Detailed Description of Actions and Entries

Appendix B Topics

Appendix B provides detailed information on each SIGNAL2000 command and any associated parameter values. The commands are listed in alphabetical order. This appendix includes the 22 basic TEAPAC commands as well as the unique SIGNAL2000 commands. Five specific categories of information are provided for each command, as described below:

COMMAND	**<Parameter Name>**	**5*<Another Parameter>**
Defaults:	[default for <Parameter Name>]	5*[default for <Another Parameter>]
Menus/Groups:	[<menu/group name>]	

This section shows the proper usage format of the command, including the parameter values and their order of input. The command is in capital letters and parameter names are in angle brackets, "< " and ">". An integer followed by an asterisk, "*", indicates that the parameter can be repeated the specified number of times (five times in the example).

Below the command line, each of the default values for each parameter is shown, followed by a list of any menu/group names to which the command belongs, other than [ALL]. This is followed by a description of the purpose of the command.

For each parameter listed, a separate paragraph provides a complete description of the parameter, its allowed values and its default value.

All of the parameters descriptions are followed by a section of Notes which describe any special information, warnings and other "hints" to insure the proper use of the command.

Appendix B Topics

Alphabetical List of Commands

Commands:

LOAD
MAP
MASTERNODE
MESSAGES
METROAREA
MINIMUMS
MOVLABELS
NETWORK
NEWPAGE
NEXTLINES
NODELIST
NODELOCATION
NOTE
NSTOPFACTORS
OFFSET
OPTIMIZE
OUTPUT
OVERLAPS
PARKINGSIDES
PARKVOLUMES
PATHASSIGNMENT
PATHDISTRIBUTION
PEAKHOURFACTORS
PEDLEVELS
PEDTIME
PERIODS
PERMISSIVES
PHASEMOVEMENTS
PROJECT
QUEUECALCS
QUEUEMODELS
REPEAT
REQCLEARANCES
RESET
RETURN
RIGHTTURNONREDS
ROUND
ROUTE
SATURATIONFLOWS
SAVE
SEQUENCES
SERVICEVOLUMES
SIMULATION
SITESIZE
SORT

STARTUPLOST
STOP
STORAGE
SUBSYSTEM
SUMMARISE
TIMINGS
TRUCKCOUNTS
TRUCKPERCENTS
UPSTREAMVC
UTILIZATIONS
VEHICLECOUNTS
VOLADDITIONALS
VOLFACTORS
VOLUMES
WIDTHS
YELLOWTIMES

ACTUATIONS 12*<Actuated Movement>

Defaults: 12*NO
Menus/Groups: [PARAMETERS] [BASIC] [MOVEMENT]

The purpose of this command is to enter the type of phase module present, actuated or non-actuated, for each movement of the current intersection for use in the determination of the Delay Calibration Term (k).

<Actuated Movement> is a keyword describing whether or not the movement is part of an actuated phase, or the unit extension value (sec) of the actuated phase, and can have the values described below:

NO - the movement is not part of an actuated phase (default).
YES - the movement is part of an actuated phase (unit extension is 3 sec.).
0.2-30.0 - unit extension in seconds.

Notes

- ACTUATIONS are used in conjunction with v/c to determine the Delay Calibration Term, according to Exhibit 16-13 of the 2000 *Highway Capacity Manual*.

- Specifying YES or giving extensions for all non-zero lane groups indicates a fully actuated signal. Specifying NO for all non-zero lane groups indicates a pretimed signal. Specifying YES or giving extensions for some, but not all, non-zero lane groups indicates a semiactuated signal.

- An ARRIVALTYPE value other than 3 may be used for a movement with ACTUATIONS set to something other than NO, but only where it is clear that the coordinated movement is truly actuated when it is also coordinated.

ADTFACTOR <Factor to Expand Counts to 24 Hour Volumes>

Defaults: 0.0
Menus/Groups: [PARAMETERS] [TURNS/WARRANTS]

The purpose of this command is to enter a factor which will be used to estimate 24-hour volumes from partial day's counts at the current intersection.

<Factor to Expand Counts to 24 Hour Volumes> is a factor which, when multiplied by the entire counted traffic, will produce a reasonable estimate of 24-hour traffic volumes, or average daily traffic (ADT). It can be any decimal number from 0.0 to 100.0. Its default value is 0.0.

Notes

- The single factor entered on the ADTFACTOR command is used in Usage Level 2 of WARRANTS to multiply the total counted volume of each movement to estimate the 24-hour volume of each movement. This 24-Hour Volume Estimates report is produced at the end of the ANALYZE outputs when the default ANALYZE command is used. It is not produced if a specific time range is selected for the ANALYZE command. The REPORTS command can also be used to produce the 24-Hour report using the ADT option in the list of reports.

- When the ADTFACTOR is zero, the default value, the 24-Hour Volume Estimates report is omitted under all conditions.

ANALYZE --

Defaults: --
Menus/Groups: [RESULTS] [ANALYZE] [DESIGN]

The purpose of this command is to perform a capacity analysis of a specified phasing and timings for the current intersection or all intersections. It has no parameters.

Notes

- Before this command can be properly executed, the phasing and timings must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES and CYCLE commands or the TIMINGS command.

APPLABELS 4*<Approach Label>

Defaults: N E S W
Menus/Groups: [PARAMETERS] [BASIC] [APPROACH]

The purpose of this command is to enter labels for each approach of the current intersection.

<Approach Label> is a two-character abbreviation for each of the four approaches at the intersection, and can be any two characters. Its default value is N, E, S, & W for each of the approaches, respectively.

Notes

- Alternate labels could be, for example, SB, WB, NB, & EB, respectively, or A, B, C, & D.

- Use of APPLABELS does not change the order of entry -- this order is always clockwise starting with the north approach. APPLABELS merely allows each approach to be labeled with the user's choice of characters.

ARRIVALTYPES 12*<Quality of Progression>

Defaults: 12*3
Menus/Groups: [PARAMETERS] [BASIC] [MOVEMENT] [94DEFAULTS]

The purpose of this command is to enter the quality of progression for each movement of the current intersection.

<Quality of Progression> specifies various types of parameters related to the quality of progression for use in the determination of the Delay Adjustment Factor, and can take on values in the ranges described below:

0 <= Value <= 6	indicates the actual Arrival Type.
7 <= Value <= 300	indicates the value entered is the percentage of platoon ratio (RP).
-100 <= Value <= -1	indicates the value entered is the negative of the percentage of all vehicles in the movement arriving during the green phase (PVG).

Its default value is 3 for all movements.

Notes

- ARRIVALTYPES is used for computing the Progression Adjustment Factor according to Exhibit 16-12 of the 2000 *Highway Capacity Manual*.

- For RP values less than or equal to 6%, use Arrival Type 1.

- If the value is entered as either PVG or RP, the program will determine the arrival type based on the method outlined in the 2000 *Highway Capacity Manual*. Values 1 through 6 are defined as in Exhibit 16-11 of the manual.

- An ARRIVALTYPE value other than 3 may be used for a movement with ACTUATIONS set to something other than NO, but only where it is clear that the coordinated movement is truly actuated when it is also coordinated.

- Note that although many intersections in a network may be entered into SIGNAL2000, the arrival type is a user entry and is not determined by the program based on flows from other intersections in the network.

ASK <List of Commands>

Defaults: [PARAMETERS]
Menus/Groups: [DATAFILES]

The purpose of this command is to produce a dialog box display for each of the listed commands.

<List of Commands> is a set of commands and/or group names, and can be any valid commands or group names of the program. Its default value is [PARAMETERS] - all nonactive commands for entry of parameters related to the analysis procedures.

Notes

- The ASK command will prompt the user for entry of parameter values for each of the commands in the list. An input dialog for each command (Normal View) or the entire list (Tabular View) will be initiated showing the current DATA values and a line of HELP at the bottom of the dialog.

- When a correctable error is detected in the parameter list of any command entered from the Manual Mode, the ASK command is automatically performed for that command in order to allow re-entry of the parameter(s) in error.

- ASK may only be used from the Manual Mode. It is a powerful way to review current data values and to allow any necessary changes to be made simultaneously. It can also be used to create custom input and action sequence displays.

ASSIGNMENT	**<Type #>**	**<Intersection #>**
	12*<<Movement #> <Assignment Factor>>	
Defaults:	-	-
	12*<0 0>	
Menus/Groups:	[PARAMETERS] [SITE]	

The purpose of this command is to enter the percentage of a distribution type to be assigned to the movements at an intersection. This is only used to define special assignment situations, and is not normally used for typical site traffic assignment situations.

<Type #> is the number of the distribution type being assigned, and can be 1-150 (see note below). It has no default value, it must be entered.

<Intersection #> is the number of the intersection to which traffic is being assigned as defined on the INTERSECTION command, and can be 1-999 (see note below). It has no default value; it must be entered.

<Movement #> is the movement number to which the traffic is being assigned, and can be any integer from 0 to 12, as described below:

1-12 - one of the turning movements.
0 - designates that a list of assignments for all 12 movements will follow.

It has no default value; it must be entered.

<Assignment Factor> is the percentage of the traffic of the distribution type being assigned that is assigned to the specified movement, and can be 0-100 percent. Its default value is 0.

Notes

- The purpose of this command is to give the greatest degree of freedom in assigning traffic for a given distribution type to a given intersection. When this technique is used, SITE cannot check that the entered values are consistent with upstream and downstream assignments, as is the case when using the PATHASSIGNMENT command. As such, ASSIGNMENT should only be used in those rare instances when the PATHASSIGNMENT command cannot achieve the desired special-purpose assignment. It can also be used when using old SITE data files which were created before the PATHASSIGNMENT command was available.

- <Type#> may not exceed the limit previously set with the SITESIZE command, and <Intersection #> must represent a node included in the NODELIST command.

- Movement numbers begin with the north leg right-turn as movement number 1, and proceed clockwise around the intersection to movement number 12.

- Multiple pairs of movement numbers and their associated assignment factors may be entered on one ASSIGNMENT command. They should be entered one after the other at the end of the ASSIGNMENT command.

BASE	<Generation Base>	<X-Y Coord LL>	<X-Y Coord UR>
Defaults:	0	0 0	0 0
Menus/Groups:	[PARAMETERS] [SITE]		

The purpose of this command is to enter the base development size for generating trips as it relates to the generation rates used for the development.

<Generation Base> is the base development size to which the traffic generation rates are applied, and can be any integer from -9999 to 32767. Its default value is 0.

<X-Y Coord LL> are the X and Y coordinates of the lower-left (southwest) corner of the site for display in the schematic diagram, and can be any common coordinate system value, as an integer from -2,147,483,647 to 2,147,483,647. Its default value is 0,0.

<X-Y Coord UR> are the X and Y coordinates of the upper-right (northeast) corner of the site for display in the schematic diagram, and can be any common coordinate system value, as an integer from -2,147,483,647 to 2,147,483,647. Its default value is 0,0.

Notes

- The coordinate system used for BASE should match that used by each NODELOCATION command.

BIKEVOLUMES 4*<Conflicting Bicycles>

Defaults: 4*0
Menus/Groups: [PARAMETERS] [APPROACH]

The purpose of this command is to enter the volume of conflicting bicycles for right turns on each approach of the current intersection.

<Conflicting Bicycles> is the volume of conflicting bicycles, in bikes per hour, for right turns on the approach, and can be any integer from 0 to 2000. Its default value is 0.

Notes

- Entries for bicycle interference should be made for the approach from which the conflicting right turn is made. For example, bicycles crossing the east leg of the intersection interfere with right turns made from the south approach, so the <Conflicting Bicycles> value for that right turn should be input for the south approach.

BUSVOLUMES 4*<Stopping Bus Volume>

Defaults: 4*0
Menus/Groups: [PARAMETERS] [APPROACH]

The purpose of this command is to enter the volumes of stopping buses which stop on each approach of the current intersection.

<Stopping Bus Volume> is the hourly volume of local buses which stop at the bus stop designated for the approach, and can be any integer from 0 to 250. Its default value is 0, no stopping bus volume.

Notes

CALCULATE <Algebraic Expression>

Defaults: none
Menus/Groups: [CONTROL]

The purpose of this command is to perform a calculation for the given expression and optionally assign the integer result to a user variable.

<Algebraic Expression> is an expression in the form of an algebraic formula or equation, and can be any valid expression containing numeric constants, user variables and valid operators, as described below. It has no default value; it must be entered.

Notes

- The expression entered must be of the form of a normal algebraic expression using any of the four operators +, -, * and / (addition, subtraction, multiplication and division). This means that each operator must have two operands, one on either side of the operator. An operand may be either a numeric constant or one of the 26 1-character user variables A - Z. User variables must have had values assigned to them by a previous CALCULATE command or with a REPEAT command. A minus sign may also be used as a single operand operator to reverse the sign of the following constant or variable.

- Expressions are evaluated from left to right, except that multiplication and division operations always precede addition and subtraction. This order of precedence can be altered by surrounding parts of the expression which should be evaluated first with parentheses.

- If the result of the calculation is to be saved as the value of a user variable (A - Z), the single-character variable name should precede the expression and be separated from the expression with an equal sign, representing a normal algebraic equation. The value assigned to the variable will be rounded to the nearest integer, as described below.

- All internal calculations for the expression are made using 32-bit decimal arithmetic. The result is displayed in a format with four decimal places that can handle numbers less than 10 billion (1 x 10^10) and greater than -1 billion (-1 x 10^9). Regardless of the number of digits shown in the result, only 6-7 digits of accuracy exist; any other digits that are shown may be random.

- When a result is assigned to a user variable, the result is rounded to the nearest integer value. Results assigned to user variables must be less than or equal to 32,767 and greater than or equal to -32,768.

- If a variable is used in a calculation before its value has been assigned by a CALCULATE or REPEAT command, its value will be zero.

CONDITIONS **<Major Direction> <# N-S Lanes> <# E-W Lanes>**
<High Speed> <Low Population>
<Progression Impact> <Remedial Actions Failed>
<# Accidents for Signal> <Stop Sign Delay>
<# Accidents for Stop> <Minor Street Delay>

Defaults: NORTHSOUTH 1 1 NO NO NO NO 0 0 0 0
Menus/Groups: [PARAMETERS] [TURNS/WARRANTS]

The purpose of this command is to enter intersection conditions which affect the conduct of a Warrant Analysis at the current intersection.

<Major Direction> is a keyword which describes whether the major street is counted on the North-South approaches or East-West approaches. It can be any of the following:

NORTHSOUTH - major street counted on North & South approaches (default).
EASTWEST - major street counted on East & West approaches.

<# N-S Lanes> is the number of lanes for moving traffic on each of the North and South approaches. It can be any integer from 1 to 4. Its default value is 1.

<# E-W Lanes> is the number of lanes for moving traffic on each of the East and West approaches. It can be any integer from 1 to 4. Its default value is 1.

<High Speed> is a keyword which describes whether the 85th percentile speed of major street traffic exceeds 40 mph. It can be any of the following:

NO - major st. speeds don't exceed 40 (default).
YES - major street speeds exceed 40 mph.

<Low Population> is a keyword which describes whether the intersection is in an isolated community with a population less than 10,000. It can be any of the following:

NO - population is not less than 10,000 (default).
YES - population is less than 10,000.

<Progression Impact> is a keyword which describes whether a signal installation will <u>not</u> seriously disrupt progressive traffic flow. It can be any of the following:

NO - signal will disrupt progression (default).
YES - signal will not disrupt progression.

<Remedial Actions Failed> is a keyword which describes whether trials of less restrictive remedies have failed. It can be any of the following:

NO - other remedies have not failed (default).

YES - other remedies have failed.

<# Accidents for Signal> is the number of reported accidents, correctable by traffic signal control, within a 12-month period. It can be any integer number from 0 to 20. Its default value is 0.

<Stop Sign Delay> is the number of vehicle-hours of peak hour stop sign delay experienced by traffic on one minor approach of the intersection. It can be any integer from 0 to 20. Its default value is 0.

<# Accidents for Stop> is the number of reported accidents, correctable by multi-way stop control, within a 12-month period. It can be any integer number from 0 to 20. Its default value is 0.

<Minor Street Delay> is the average peak hour delay experienced by traffic on all minor approaches of the intersection in seconds/vehicle. It can be any integer from 0 to 300. Its default value is 0.

Notes

- The data entered for the CONDITIONS command are used by the WARRANTS command in WARRANTS and Usage Level 2 of TURNS to describe intersection conditions which affect the warrant levels and conditions which must be met to satisfy the warrants.

- <# N-S Lanes> and <# E-W Lanes> is the number of lanes for moving traffic on each of the North-South and East-West approaches, respectively, and normally does not include exclusive turn lanes. It is the number of lanes on each approach, not the total number of lanes on the street. If the actual number of lanes exceeds the maximum allowed entry of 4, enter 4 (the MUTCD only considers whether there is 1 lane or more than 1 lane).

COUNTTYPE <Type of Data> <Type of Truck Counts> <Count Description>

Defaults:	REDUCED 40 blanks	INCLUDED
Menus/Groups:	[PARAMETERS]	[TURNS/WARRANTS]

The purpose of this command is to enter the type of count data which is to be supplied to the program at the current intersection, and to provide a description of the count.

<Type of Data> is a keyword which defines the type of count data which will be entered on the VEHICLECOUNTS and TRUCKCOUNTS commands, and can be any of the following:

CUMULATIVE	The count data entered is the cumulation of traffic counted from the start of the survey.
REDUCED	The data entered is the actual volume counted for the count interval (default).

<Type of Truck Counts> is a keyword which defines the type of truck count data which will be entered on the VEHICLECOUNTS and TRUCKCOUNTS commands, and can be any of the following:

INCLUDED	VEHICLECOUNTS data includes truck counts entered with the TRUCKCOUNTS command (default).
SEPARATE	VEHICLECOUNT data does not include truck counts entered with the TRUCKCOUNTS command.

<Count Description> is a 40-character description of the count that was conducted, to include such things as the date, weather, count station, etc. The default value is all blanks.

Notes

- If entered data is declared CUMULATIVE, the data entered is the cumulation of traffic counted from the start of the survey, starting at an arbitrary value (sometimes 0). The actual volume will be the subtraction of successive cumulative entries. For REDUCED counts, the data entered is the actual volume counted for the count interval.

- When truck counts are INCLUDED, the truck counts entered with the TRUCKCOUNTS commands are also included in the VEHICLECOUNT data values and no adjustments are made by the program. When truck counts are declared SEPARATE, the truck counts entered with the TRUCKCOUNTS commands are not included in the VEHICLECOUNTS data values, so must be added to VEHICLECOUNTS by the program to get total traffic numbers.

CRITICALS 6*<Critical Movement Number>

Defaults: 6*0
Menus/Groups: [PARAMETERS] [PHASING] [ANALYZE]

The purpose of this command is to enter the movement which is critical for each phase of the phase sequence of operation of the current intersection.

<Critical Movement Number> is the movement number designating the movement which controls the design of the signal phase, and can be 0-12. Its default value is 0, no critical movement.

Notes

- Designation of a critical movement in any phase will result in that movement appearing with asterisks in the phase movement diagram. This is normally used to represent movements which were used to control a DESIGN. This diagram appears as part of the DIAGRAMS, ANALYZE, EVALUATE and QUEUECALCS reports. If a movement is designated as critical in any phase, the line for that movement in the ANALYZE report is flagged with an asterisk in the LOS column.

- The TIMINGS command automatically implements a CRITICAL command for the phases of the specified sequence which have been DESIGNed.

CYCLES <Minimum Cycle> <Maximum Cycle> <Cycle Increment>

Defaults:	60	120	30
Menus/Groups:	[PARAMETERS] [BASIC] [PHASING] [ANALYZE] [DESIGN]		

The purpose of this command is to enter the range and precision of cycle length scanning for the current intersection for DESIGN, as well as the default cycle length for the ANALYZE, EVALUATE, QUEUECALCS, SERVICEVOLUMES, GOVERCS and EXPORT commands if timings for these commands are not provided in seconds.

<Minimum Cycle> is the smallest cycle length in seconds which should be tested by the DESIGN procedure for operational feasibility. This is also the default cycle for ANALYZE, EVALUATE, QUEUECALCS, SERVICEVOLUMES, GOVERCS and EXPORT. It can be any positive integer from 1 to 900 seconds. Its default value is 60 seconds.

<Maximum Cycle> is the largest cycle length in seconds which should be tested by the DESIGN procedure for operational feasibility, and can be any positive integer equal to or larger than <Minimum Cycle> from 1 to 900 seconds. Its default value is 120 seconds.

<Cycle Increment> is the precision to which the specified cycle length range will be investigated as to operational feasibility, i.e., the increment of cycle length which will be added to <Minimum Cycle> until <Maximum Cycle> is exceeded. It can be any positive integer from 1 to 900 seconds. Its default value is 30 seconds.

Notes

- In ANALYZE, EVALUATE, QUEUECALCS, SERVICEVOLUMES, GOVERCS and EXPORT, if all of the GREENTIMES or all of the YELLOWTIMES are entered in seconds per second (sec/sec), the <Minimum Cycle> will be used to convert these entries to seconds before proceeding with the analysis.

- If signals at minor intersections in the system will be run at cycle lengths which are half that of the major intersections, commonly called "double-cycling", the system cycle length entered by the CYCLES entry for the MASTERNODE should be the longer cycle length used at the major intersections. The GREENTIMES and YELLOWTIMES for the double-cycled minor intersections should be entered in seconds (not sec/sec) and add up to half of the system cycle and the half-cycle should be entered for the minor intersections. OFFSETS should also be entered in seconds (not sec/sec).

DATA <List of Commands>

Defaults: [PARAMETERS]
Menus/Groups: [DATAFILES]

The purpose of this command is to display the current parameter values for the specified commands.

<List of Commands> is a set of commands and/or groups names, and can be any valid commands or group names of the program. It default value is [PARAMETERS] - all non-active commands for entry of parameters related to the analysis procedures.

Notes

- DATA will tabulate a list of the current parameter values of the listed commands. To obtain a formatted list of all data values with column headings and labels, etc., use the SUMMARISE command.

- In the Manual Mode of menu versions of TEAPAC programs, use of ASK for the same list of commands will display the current data values, as well as allow any input editing which may be needed, all in a single step.

DELAYFACTORS 12*<Delay Adjustment Factor>

Defaults:	12*1.00
Menus/Groups:	[PARAMETERS] [MOVEMENT]

The purpose of this command is to enter factors for each movement of the current intersection used to adjust the delay calculations, for example, to match delays obtained from a network simulation model.

<Delay Adjustment Factor> is the factor to adjust delay calculated for each movement, and can be any number from 0.01 to 9.99. Its default value is 1.00, no adjustment.

Notes

- If delay values have been simulated with a network model such as TRANSYT-7F or NETSIM/CORSIM which does a better job of modeling delay between coordinated signals than the 2000 *Highway Capacity Manual* allows, DELAYFACTORS may be used to force the calculations of delay in SIGNAL2000 to the same values. For example, if SIGNAL2000 calculates delay of 20 seconds, but TRANSYT7F estimates 16 seconds, use a DELAYFACTOR of 0.80.

DESCRIPTION <Second Title Line>

Defaults: 80 blanks
Menus/Groups: [TITLES]

The purpose of this command is to enter the second line of information used to identify the situation being analyzed.

<Second Title Line> is the second of three lines of information displayed at the top of every output report, and can be up to 80 characters of alphabetic or numeric information. Its default value is 80 blanks.

Notes

- If the first character of the DESCRIPTION parameter is a plus sign, "+", the characters entered on this command will be overlaid over those of the previously entered DESCRIPTION command. This overlay will begin at the character position identified by the digits of the first two characters which follow the "+", and will end after the last non-blank character which is entered. See Chapter 5 of the *TEAPAC Tutorial/Reference Manual* for further explanation and examples of this feature.

- Entries on this command may be enclosed in 'single quotes' or "double quotes". This option provides the capability to include leading blanks in the entry, which is otherwise not possible. This option can also be used to enter a single blank as the title line using a ' ' or " " entry, thereby blanking out the entire prior contents of the title line.

- The name of the current open file can be inserted anywhere in the title line by placing %F at the desired location of the title line. The file name can be placed at a specific column location in a title line by using the +XX form of a title entry noted above.

DESIGN <Number of Sequences to Analyze>

Defaults: 1 - 1 capacity analysis of best sequence & cycle follows DESIGN
Menus/Groups: [RESULTS] [DESIGN]

The purpose of this command is to perform an operational design to optimize timings for each sequence of the SEQUENCES command and each cycle of the CYCLES command for the current intersection or all intersections. This is a Usage Level 2+ command.

<Number of Sequences to Analyze> is the number of sequences for which capacity analyses shall be performed based upon optimum timings resulting from the design, and can be 0, 1-64, or -1. Its default value is 1 - 1 capacity analysis of best sequence & cycle follows DESIGN.

Notes

- DESIGN optimizes green times with the default objective that each critical movement will get the same best-possible level of performance (typically minimum delay). Non-critical movements will get at least this level or better. The target level of performance is the first parameter of the LEVELOFSERVICE command. See Appendix C for a complete discussion of the optimization scheme and options used in SIGNAL2000, such as designating priority movements with the EXCESS command.

- A design criteria based on v/c only may be used by setting the Target Delay parameter of the LEVELOFSERVICE command to 0. This will effectively balance the v/c values of the critical movements. This strategy is used by DESIGN automatically when the highest allowed delay value cannot be achieved. See Appendix C for a complete discussion of the optimization scheme and options used in SIGNAL2000.

- When a value of 0 is used for <Number of Sequences to Analyze>, DESIGN will produce a table with the critical level of service achieved for each combination of phase sequence and cycle length attempted. Inappropriate sequences will be marked with a dash '-'. If the Detail option of the OUTPUT command is selected, the actual target achieved will also be displayed for each combination in an expanded table of results.

- If a positive value is entered for <Number of Sequences to Analyze>, the list of successful sequences as described above is omitted. This list is replaced by the SORT command output, a list of successful sequences which is sorted in ascending order by target achieved and Required G/C + Y/C. This list also contains the range of cycle lengths which were successful at that target for each sequence. Following the list of sorted sequences are the capacity analyses for the specified number of sequences at the top of the SORTed list, performed automatically by the ANALYZE command.

- If a negative number is entered for <Number of Sequences to Analyze>, the design procedure is completed in the same manner as with a zero (see above), however, no output is generated. Use this for a single intersection only -- although functional for a selection of All intersections (INTERSECTION 0), it is of no value since the only meaningful commands which could follow are SORT or TIMINGS, but neither is valid for All intersections.

- Extra output normally displayed with the DESIGN report when OUTPUT is specified will not be displayed when the DESIGN parameter is non-zero, for example, when DESIGN 1 or DESIGN -1 is entered.

- Commands which guide the DESIGN process include MINIMUMS, REQCLEARANCES, EXCESS, LEVELOFSERVICE, CYCLES, SEQUENCE and OUTPUT.

DIAGRAMS <Sequence Code>

Defaults: -1
Menus/Groups: [RESULTS] [ANALYZE]

The purpose of this command is to display a phase movement diagram for the specified sequence code for the current intersection.

<Sequence Code> is the phasing code number specifying the phase sequence which is to be diagrammed, and can be a standard, special or positional code, as follows:

Standard phasing code:	11, 12, 13, etc.
Special phasing code:	0.
Positional codes:	-1, -2, -3, etc.
	(default -1, first sequence in SEQUENCES list)

Notes

- If a negative number is given as a sequence code, this represents the sequence code position in the SEQUENCES list, i.e., minus three will produce a phase diagram for the third sequence code in the SEQUENCES list.

- If an asterisk is given as the sequence code, all codes in the SEQUENCES list will be diagrammed. For example, if SEQUENCE ALL has been specified, DIAGRAM * will produce a list of all possible phasings considered by SIGNAL2000.

- Arrows are shown in the DIAGRAM only for movements with non-zero VOLUMES.

ECHO <Input/Output Echo Condition>

Defaults: NO
Menus/Groups: [DATAFILES]

The purpose of this command is to enter the echo condition flag indicating whether or not command information should be displayed after being input from or output to a file.

<Input/Output Echo Condition> is a keyword describing whether or not file input and output should be echoed, and can be either of the keywords described below.

NO	File I/O will not be echoed (default).
YES	File I/O will be echoed.

Notes

- When data is LOADed from or SAVEd to data files, listings of the actual data lines being transferred can be obtained by first setting the ECHO parameter to YES. This is a convenient way to visualize what is happening during LOADs and SAVEs. As such, it is also a powerful tool for debugging complicated batch control file sequences.

- ECHO can also be used to view some other file data transfer functions such as outputting volumes to files from TURNS and SITE for use by SIGNAL2000, etc.

ENDGAIN **12*<End Gain Time>**

Defaults: 12*2.0
Menus/Groups: [PARAMETERS] [MOVEMENT]

The purpose of this command is to enter the length of time that vehicles effectively extend the green period into the yellow and all-red period for each of the twelve movements of the current intersection.

<End Gain Time> is the number of seconds during the yellow and all-red period which is effectively used as green time, and can be any number from 0.0 to 30.0. Its default value is 2.0.

Notes

- STARTUPLOST time is used in conjunction with ENDGAIN time to calculate the lost time that an individual movement experiences during its green phase(s). The formula used from the 2000 *Highway Capacity Manual* is $t_L=l_1+l_2$, where l_1 is the startup lost time, l_2 is the ending lost time; and l_2=Y-e, where e is the endgain time.

- If the default values of STARTUPLOST and ENDGAIN (both are 2 seconds) are used for a particular movement, the lost time formula simplifies to t_L=Y. Since Y values (yellow plus all-red time) are typically in the range of 4-6 seconds, this default condition may result in lost times considerably higher than the default lost time value of 3.0 seconds which was used in the 1985 and 1994 *Highway Capacity Manuals*. When this is the case, users should expect less effective green time for these movements versus those used in comparable 1985 and 1994 analyses, which will result in higher v/c and delay values, and thus likely worse levels of service.

EVALUATE --

Defaults: --
Menus/Groups: [RESULTS] [ANALYZE] [DESIGN]

The purpose of this command is to display a performance evaluation for a specified phasing and timings for the current intersection or all intersections. It has no parameters.

Notes

- Before this command can be properly executed, the phasing and timings must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES and CYCLE commands or the TIMINGS command.

EXCESS <List of Priority Movement Numbers>

Defaults: 0
Menus/Groups: [PARAMETERS] [INTERSECTION] [DESIGN]

The purpose of this command is to enter the movements to which the TIMINGS command will assign available excess portions of the cycle length for the current intersection.

<List of Priority Movement Numbers> is the movement numbers for the movements which should receive available excess time, and can be 0-12. Its default value is 0, no priority movements.

Notes

- For DESIGN, the <Target Delay/LOS> entry of the LEVELOFSERVICE command sets the target delay (or level of service) which is to be achieved for all critical movements of the intersection. If this target level is achieved with excess time still available at the intersection, then the excess time is assigned to the phases according to the entries on the EXCESS command. If no EXCESS entries have been made, time is allocated proportionally to all phases. However, if EXCESS is used, this provides a means to designate a worst-case delay/LOS performance level for all critical movements and to assign all additional time to the priority movements of the EXCESS command. This is the preferred optimization scheme for the DESIGN function of SIGNAL2000 (see Appendix C for more details).

- The excess time will be allocated to the phases in which the specified movements occur. If the movements specified occur in more than one phase, the excess time will be allocated to each in proportion to the g/C required by each.

- If a specified movement occurs in more than one phase, its excess time phase will be designated as the single phase serving the movement (i.e., if movement 2 is specified with sequence 21, the excess will go to the north-south through phase).

EXPORT <File name/AUTO>

Defaults: --
Menus/Groups: [RESULTS] [ANALYZE] [DESIGN]

The purpose of this command is to create an HCS-compatible input data file from the current data values for the current intersection, with an optional automatic link to HCS.

<File Name/AUTO> is the name of the HCS data file to export to, and can be any valid file name, or the keyword AUTO. Its default value is AUTO.

Notes

- The SEQUENCES, CYCLES, GREENTIMES and YELLOWTIMES commands must first be input to SIGNAL2000 before the EXPORT command. Normally, EXPORT will be executed following the DESIGN, SORT, TIMINGS sequence of commands, or the DESIGN 1 command for optimization of timings and phasings by SIGNAL2000.

- To perform computations with HCS comparable to the ANALYZE command of SIGNAL2000 using an EXPORTed file, simply select the HCS File-Open menu and select the name of the file EXPORTed.

- The default file name extension is .XHS or .XHU for HCS+. The export will be created for HCS+ if any file name extension other than HCS, HC9 or SIG is used. Use of .HCS will cause an HCS2000 export (also useable by HCS Release 3), .HC9 will cause a Release 2.4 export, and .SIG will cause a Release 1.x export.

- If <File/AUTO> is the name of a file that does not (or should not) already exist, the automatic creation queries can be avoided by using the normal TEAPAC file name switch, "/N", as described in Appendix G. If it doesn't matter if the file exists or not, the "/O" switch can be used.

- A direct linkage to HCS+ Signals or Unsignal can be created which handles the export file naming and running of HCS+. This option is selected by entering AUTO as the EXPORT file name. AUTO may not be abbreviated, nor may any file name used start with the four letters A-U-T-O. When the AUTO option is selected, the export file name used is TMPHCS.XHS (Signals) or TMPHCS.XHU (Unsignal).

- In order for the AUTO option of EXPORT to function properly, the SIGNAL20.CFG file must be configured to properly represent the folders where the TEAPAC, SIGNAL2000, data and HCS files are stored (see Options-Setup menu for on-screen editing of the SIGNAL20.CFG file).

- The "street names" for HCS come from the INTERSECTION command. The north/south street name is assumed to be anything preceding an "&" and the east/west name is anything after the "&". The "analysis time" for HCS comes from the first 30 characters of the NOTE command, the "analysis year" comes from the second 30 characters of the NOTE, and the "analysis date" comes from the system clock. . The "analysis by" field for HCS comes from characters 61-80 of the NOTE command. The "project description" comes from the first 60 characters of the PROJECT command. The "intersection name" come from the first 30 characters of the DESCRIPTION command (which will normally not be a description of the intersection), and the "jurisdiction" comes from the second 30 characters of DESCRIPTION.

- Do not use the double quote character (") or the ampersand character (&) anywhere in character entries such as [TITLES] or INTERSECTION, as this will cause data values in the exported file which cannot be read properly by HCS. The exception to this rule is the user should specifically use ampersand (&) to separate the street names in the INTERSECTION entry.

- The pedestrians are assumed to walk during the phase with the adjacent through movement if the ped volume is not zero. The minimum phase time for those peds is taken as the minimum for that through movement. Ped buttons are always set to "N" since this is not a SIGNAL2000 input.

- In versions of HCS prior to HCS+ the HCS parking flag is set on only if parking exists on the right side of an approach, since these earlier versions of HCS do not treat left side parking.

- HCS.SIG files for Releases 1.x do not save utilization factors used in the analysis. Thus, it may be necessary to re-enter utilizations in the HCS analysis to match those used in the SIGNAL2000 analysis.

- For conversion to HCS.SIG input for Releases 1.x, the arrival type of the through movement in SIGNAL2000 is used for the approach arrival type in HCS.

- The heavy vehicle percentage used for each HCS.SIG approach is the weighted average percentage of heavy vehicles given for the individual movements in SIGNAL2000.

FACTORS 12*<Satflow Adjustment Factor>

Defaults: 12*1.00
Menus/Groups: [PARAMETERS] [MOVEMENT]

The purpose of this command is to enter satflow adjustment factors for each movement of the current intersection to adjust 2000 *Highway Capacity Manual* satflow computations.

<Satflow Adjustment Factor> is an adjustment factor which, when multiplied by satflows obtained from the 2000 *Highway Capacity Manual*, produce satflows that more accurately reflect conditions known to exist in the study area. It can be any number from 0.01 to 9.99. Its default value is 1.00, no adjustment.

Notes

- FACTORS are useful in adjusting 2000 *Highway Capacity Manual* computations to match surveyed satflows (i.e., calibration).

- FACTORS may also be useful in estimation of special-use lane satflows (i.e., dual-optional turn lanes - see Chapter 5).

FILES 5*<File Name>

Defaults: 5*nul
Menus/Groups: [DATAFILES]

The purpose of this command is to enter the names of the permanent storage file areas where information is to be LOADed and SAVEd.

<File Name> is the name of the file to be used, and can be any valid file name (see Appendix G). Its default value is no defined file.

Notes

- FILES can be used so that the program remembers the name of the file to be used by subsequent LOAD and SAVE commands, thus avoiding the file name entry for each LOAD and SAVE.

- The file numbers referenced by the file access commands are determined by the order of the file names in the FILES command. For example, the third file name specified on the FILES command is designated as file #3 for LOAD and SAVE.

- Each time a new file name is specified by a FILES command, the associated "next line" and "last line" values of the file are both reset to point to line 1.

- Appendix G describes details about specifying file names, etc. for your specific operating system. For example, new files that don't presently exist may use the /N suffix to the file name in order to allow the program to create a new file automatically, preventing accidental use of pre-existing files thought not to exist.

- If the /N suffix (switch) described above is not used to indicate the desire to create a New file, but the file named is not found, a message to this effect will be issued. At this point the user will be given the opportunity to say that the file should be created anyway. This action is presented in the form of a warning message, but is a valid way of creating new files without using the /N switch.

- If the /N switch is used, but the file named already exists, a message to this effect is issued and the user is given an option to use the existing file anyway, if desired.

- The default location for user data files is defined in the dialog opened by the Options-Setup menu. The Options-Setup dialog changes dynamically as the user navigates through the File-Open and File-SaveAs dialogs, and the current contents of the dialog can be saved at any time in the program's .CFG file by pressing the Save button in the Options-Setup dialog. This will cause this saved location to be the default file location the next and subsequent times the program is run, until a new location is saved. See the detailed discussion of program installation and CFG files in Appendix G.

GENERATION	**<Direction>**	**<Generation Rate>**	**10*<Node-Dir>**
Defaults:	-	0.000	10*<0->
Menus/Groups:	[PARAMETERS] [BASIC] [GENERATOR]		

The purpose of this command is to enter the traffic generation rates and access points and access directions for the development.

<Direction> is a keyword which describes whether the following information applies to inbound, outbound or both directions of trip generation, and can be any keyword, as described below:

IN - data applies to inbound trips only.
OUT - data applies to outbound trips only.
BOTH - data applies to inbound & outbound trips (Manual Mode only).

It has no default value; it must be entered.

<Generation Rate> is the trip generation rate to be applied to the generation base, and can be any number, which when multiplied by the BASE development size, yields the total vehicle trips generated, from -9.99 to 99.99. Its default value is 0.000.

<Node-Dir> is the node number and leg direction providing the access to the development site. For example, a 1N entry means the north leg of node 1 provides access to the site. The Node part of the entry can be 0-999 (see note below) and its default value is 0 - at least one access node is required. The Dir part of the entry is a character which describes the leg of the intersection which provides access to the site, can be either N, E, S, or W, and has no default value; it must be entered for every non-zero Node entry.

Notes

- The Node part of <Node-Dir> must be included in the list of intersections previously established with the NODELIST command.

- If a previously entered list of access nodes must be shortened, the entry of Node number 0 anywhere in the list will erase all nodes and directions from that point to the end of the list.

GOTO <Destination>

Defaults:	next
Menus/Groups:	[CONTROL]

The purpose of this command is to divert the input stream within a file by providing the next location to be LOADed from that file.

<Destination> is a number which defines the next line number which will be LOADed from the current file, or a variable name associated with a REPEAT loop, and can be any valid line number of the current file less than or equal to 32767 (positive, negative or zero), or any REPEAT loop variable name that is currently in use. Its default value is the line number which follows the line which contains the GOTO command.

Notes

- A REPEAT loop variable name can be used with GOTO if the same variable name is in active use by a REPEAT command. In addition, the GOTO command can only be encountered when its associated REPEAT command is the most active REPEAT command. This means that REPEAT loops must not partially overlap one another - i.e., one must be entirely contained within the other, or they must be completely separate from each other.

- A negative line number of -n will divert input to a point in the current file n lines before the line which follows the GOTO command - i.e., GOTO -5 sets up a loop which will continue to LOAD the four lines prior to the GOTO.

GOVERCS --

Defaults: --
Menus/Groups: [RESULTS] [DESIGN]

The purpose of this command is to compute g/C's required to make each movement operate at specified levels of service for the current intersection or all intersections. It has no parameters.

Notes

- The levels of service for which the g/C's will be computed are specified by the LEVELOFSERVICE command.

- Before this command can be properly executed, the phasing and timings must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES and CYCLE commands or the TIMINGS command.

GRADES 4*<Grade of Approach>

Defaults:	4*0.0
Menus/Groups:	[PARAMETERS] [APPROACH]

The purpose of this command is to enter the grade of each approach of the current intersection.

<Grade of Approach> is the grade of the approach, in percent, either positive or negative, and can be any number from -10 to 10. Its default value is 0.

Notes

- Approaches that run uphill into the intersection have a positive grade for this input. Downhill approaches have a negative grade.

GREENTIMES 6*<Phase Green Time>

Defaults: 6*0.0
Menus/Groups: [PARAMETERS] [BASIC] [PHASING] [ANALYZE]

The purpose of this command is to enter the duration of green for each of the phases of a specified phase sequence, or optionally for each of the movements, of the current intersection.

<Phase Green Time> is the duration of green for the phase or movement, given in either seconds or seconds/second, and can be any number from 0 to 900. Its default value is 0.0 seconds.

Notes

- If the list of GREENTIMES is preceded by the keyword 'Movmt', then each of the entered values will be interpreted as timings for individual through and left turn movements, clockwise around the intersection. If not, or the optional keyword 'Phase' is used, each value is for the phases defined by the SEQUENCE code.

- When entering or viewing controller timings, a Convert button appears on the GREENTIMES dialog which allows the user to select the style of entry or view, either 'By Phase' which is the traditional HCM method, or 'By Movement' which is more similar to the way timings are used on NEMA and other dual-ring controllers. If any timings are present, they will be converted to the other format at the same time, including YELLOWTIMES if the GREENTIMES dialog is displayed, and vice versa. When timings are Converted, the conversion will also include reviewing the allowed SEQUENCES list and moving the appropriate sequence code to the top of the list according to the timings present.

- It is important to make sure that YELLOWTIMES and REQCLEARANCES entries are always kept consistent with each other, especially when converting Timings by Phase to Timings by Movement and when exporting to third-party, ring-based software.

- Allowing timings 'By Movement' makes it apparent that for certain overlap phases, phase lengths which are apparently negative in the 'By Phase' method are, in fact, perfectly valid timings for dual-ring controllers, as long as the negative value of the overlap phase greentime does not exceed the yellowtime of that same phase. This permits a wider range of timings to be represented by the traditional 'By Phase' (HCM) methodology.

- 'By Movement' timings are not allowed when special phasings represented by negative SEQUENCE codes are used.

- If green times are entered in seconds/second, the first cycle length of the CYCLES command will be used to convert the phase times to seconds.

- If all entries are greater than or equal to 1.0, they are assumed to be seconds; if all entries are less than 1.0, they are assumed to be seconds/second.

- GREENTIMES can be generated by a TIMINGS command which was preceded by a DESIGN command. These GREENTIMES are provided in seconds.

- If entering GREENTIMES by phase, they must be entered in the order of the phases as specified by the SEQUENCES code and the LEADLAGS command.

- To prevent division by zero errors, all phases except overlap phases must have non-zero GREENTIMES. To analyze a phase with a greentime which is effectively zero, use 0.01 seconds. This will display as zero, but prevent division by zero errors.

- If a signal is to be double-cycled, GREENTIMES, YELLOWTIMES (and OFFSETS) must be entered in seconds (not sec/sec) which sum to 1/2 the system cycle.

GROUPTYPES 12*<Lane Group Type>

Defaults: 12*NORMAL
Menus/Groups: [PARAMETERS] [MOVEMENT]

The purpose of this command is to enter the special lane group type for each possible lane group of the current intersection, such as dual-optional lanes, free-flow lanes and sign-controlled lanes.

<Lane Group Type> is a keyword describing the type of lane group being used, and can be any of the following:

NORMAL	- normal lane group (default).
FREEFLOW	- free-flow lane group not controlled by the signal.
DUALOPTIONAL	- dual-optional lane group.
STOP	- stop sign controlled lane group (not used by SIGNAL2000).
YIELD	- yield sign controlled lane group (not used by SIGNAL2000).

Notes

- Free-flow lane groups are not controlled by the signal, having 100% greentime indications. By using the FREEFLOW option, the volume of free-flow traffic can be counted and recorded in SIGNAL2000, but the volume will not affect the capacity analysis or design.

- Dual-optional is a lane configuration where an exclusive turn lane exists and the adjacent lane group can be optionally used for turns as well (a shared lane group). This input condition is defined by flagging the exclusive turn lane group as a DUALOPTIONAL lane group. This triggers a process which approximates the number of turning vehicles in the optional lane, re-calculates the turn percentages and truck percentages in the shared lane, and removes these vehicles from the exclusive turn lane group (adding them to the adjacent shared lanes). The number of turns in the optional lane is calculated by determining the number of turns in the shared lane which would approximately balance the v/c of the two adjacent lane groups without exceeding the designated lane utilization factor for the shared lane group.

- Dual-optional lane groups defined by GROUPTYPES are identified in the output reports by placing a plus sign "+" next to the number of lanes in the turn lane group and a minus sign "-" next to the number of lanes for the shared lane group, since in effect the dual-optional status increases the amount of turning lane group capacity and reduces the shared lane group capacity.

- In the DESIGN process, the only phasing which is allowed for a dual-optional lane group is split phase (sequence 7) or an un-opposed single phase (sequence 1).

- If an intersection includes lane groups controlled by signs as defined by GROUPTYPES, SIGNAL2000 will process the information, but will skip any analysis of the intersection, with an advisory warning to this effect.

HEADING <Number of Lines>

Defaults: 3
Menus/Groups: [CONTROL]

The purpose of this command is to display the current title heading lines.

<Number of Lines> is the number of lines of the three-line heading which are to be displayed, and can be any number from 0 to 3, either positive or negative. Its default value is 3.

Notes

- The lines which will be displayed are identified by counting the number of lines requested starting at the last line of the heading, i.e., an entry of 1 will display only the last line of the heading -- the NOTE.

- In an appended output window, or within a script/control file, use of HEADING 0 will force a page break at that point in the output stream.

- HEADING -1 in a script/control file will force the update of the output window so that progressive results can be observed before the control file completes.

HELP <List of Commands>

Defaults: [PARAMETERS]
Menus/Groups: [INFO]

The purpose of this command is to display the command names, parameter descriptions, and default values for each command listed.

<List of Commands> is a set of commands and/or group names, and can be any valid commands or group names of the program. Its default value is [PARAMETERS] - all non-active commands for entry of parameters related to the analysis procedures.

Notes

- HELP provides a brief, 1-line summary for each of the listed commands, including the parameters and values expected and their default values.

- The Help-Commands menu produces the same result as using HELP [ALL], an alphabetical list of all commands, as found in Appendix A. The Manual Mode must be used for any of the other HELP command options.

- If HELP is requested for one command, the detailed help of the Help button or the F1 key found in any Visual Mode dialog is displayed, as found in Appendix B.

IDEALSATFLOWS 12*<Ideal Saturation Flow Rate>

Defaults:	12*1900
Menus/Groups:	[PARAMETERS] [MOVEMENT] [94DEFAULTS]

The purpose of this command is to enter the base (ideal) saturation flow rate for each movement of the current intersection.

<Ideal Saturation Flow Rate> is the base saturation flow rate of a single lane under ideal conditions, in pcphgpl, and can be any integer value from 0 to 3000. Its default value is 1900.

Notes

INITIALQUEUE 12*<Initial Queue Size>

Defaults: 12*0
Menus/Groups: [PARAMETERS] [MOVEMENT]

The purpose of this command is to enter the number of vehicles queued at the intersection at the start of the analysis period for each of the twelve movements of the current intersection.

<Initial Queue Size> is the number of vehicles queued at the start of the analysis period due to unsatisfied demand in the previous analysis period, and can be any integer from 0 to 999. Its default value is 0.

Notes

- If the initial queue is observed in the field, it should be the queue observed at the end of a green phase at the start of the analysis period. This observation will reflect unsatisfied demand. The queue should not be observed at the end of a red phase, since this would be a queue which also included the significant effects of cyclical queueing, not just unsatisfied demand. The observer should also take care that the observed queue is typical of other cycles at the end of green and near the start of the analysis period, and not unduly influenced by random fluctuations in demand.

- If a non-zero initial queue value is entered, SIGNAL2000 will compute the additional d_3 delay term and adjust the d_1 term as appropriate according to the methods of the 2000 *Highway Capacity Manual*. The analyst should be aware that an analysis period with an initial queue value may generate more delay per vehicle than another analysis period which has higher volume but no initial queue. Thus, it may be appropriate to investigate any time periods which follow over-saturated periods (and thus have initial queue values) to see if the delay in these periods exceeds the over-saturated time period(s).

- If an initial queue cannot be observed where it is known (by observation or analysis) that a given time period is over-saturated, it is possible to estimate the initial queue for a given period by assessing the unsatisfied demand of a previous time period. This unsatisfied demand is displayed near the bottom of the Level of Service Worksheet, as well as the Initial Queue Delay Worksheet, and is labelled Final Queue. If this method of estimating the initial queue value is used, care should be exercised in recognition of the accumulated error which might exist each time an estimated Final Queue value is transferred to the next analysis period as an Initial Queue.

INTERSECTION <Node Number> <Description>

Defaults:	0	--
Menus/Groups:	[PARAMETERS] [BASIC] [INTERSECTION]	

The purpose of this command is to select from the NODELIST the node number of the "current" intersection, and optionally enter an intersection description.

<Node Number> is a unique intersection number assigned to the intersection, and can be any integer from 0 to 999. Its default value is 0, for all intersections selected.

<Description> is the information describing the intersection, and can be up to 30 alphanumeric characters. Its default value is all blanks.

Notes

- This is one of several entries (including NODELIST, SUBSYSTEM, INTERSECTION, NODELOCATION and NETWORK) which can be made or might be altered when using the drag-and-drop network creation/editing functions in the main window. Entries made from a dialog will change the values created in the main window, and vice-versa.

- The node number entry made on the INTERSECTION command defines the "current" intersection for which subsequent intersection entry commands will apply to. The INTERSECTION command must be issued prior to any of these entry commands. The node number used must be a number already listed in the NODELIST.

- If INTERSECTION 0 is specified, this selects all intersections in the NODELIST/SUBSYSTEM for most subsequent actions of the program, such as DESIGN and ANALYZE. In addition, if RESET is used, the commands which are RESET will be reset for all intersections. For example, INTERSECTION 0 followed by RESET VOLUMES will reset the VOLUMES to zero for all intersections in the NODELIST.

- In a Visual Mode dialog that includes INTERSECTION or intersection data, the "+" button, "-" button, ^Page-Up key and ^Page-Down key can be used to, in effect, dynamically issue an INTERSECTION command for the next and previous intersection in the NODELIST. If data values are changed on a screen display, the ^Page keys should not be used before the data is first entered with the TAB key.

- Other commands (EXPORT) and programs assume certain conventions for describing intersections. For example, this should be the north-south street name first, separated from the east-west street name by an ampersand, "&".

IODEVICES	**<Visual View>**	**<Page #>**	**<Lines/Pg>**	**<Last Line #>**
Defaults:	NORMAL	0	66	63
Menus/Groups:	[CONTROL]			

The purpose of this command is to set the visual view style for dialogs, as well as the page number and the size of the output medium (i.e., paper).

<Visual View> is a keyword representing view of the Visual Mode which will be used, and can be either keyword described below.

NORMAL	the normal view of the Visual Mode (default).
TABULAR	the tabular view of the Visual Mode.

<Page #> is the number of the next page to be printed, and can be zero, -1, or any positive integer up to 32767. Its default value is 0 - do not display page number on output.

<Lines/Pg> is the number of printable lines on each page of output, and can be zero, or any positive integer up to 32767. Its default value is 66, the typical size of printed output on 8-1/2 x 11 paper at 6 lines per inch.

<Last Line #> is the number of lines, counting from the top of the page, which are to be used for printing, and can be zero, or any positive integer less-than or equal to <Lines/Pg>. Its default value is 63, which normally allows a half-inch margin at the bottom of a 66-line page.

Notes

- Printers normally print 6 lines per inch, thus an 11-inch page is 66 lines and an 8 1/2-inch page is 51 lines. Normally <Last Line #> is 3 less than <Lines/Pg> to allow a 1/2-inch margin.

- Every time a <Line/Pg> entry is made, <Last Line #> is re-calculated as 3 lines less than <Lines/Pg>. This usually provides a 1/2" margin at the bottom of each page of output. As a result, unless a different bottom margin is desired, <Last Line #> need not be entered.

- Use of <Lines/Pg> and <Last Line #> are primarily for the purposes of batch operations or any commands which generate multiple pages of output.

- If the <Page #> entry is greater than zero, this number will used to label the page number of the next printed page of output. Every time this occurs, the <Page #> is incremented so that the next printed page will be automatically numbered with the page number. If <Page #> is zero, no page number will be displayed on the printed output. If <Page #> is -1, the date and time will also be omitted from the the output.

LANES 12*<Number of Lanes>

Defaults: 12*0
Menus/Groups: [PARAMETERS] [BASIC] [MOVEMENT]

The purpose of this command is to enter the number of lanes which are assigned for use by each of the twelve movements of the current intersection.

<Number of Lanes> is the number of lanes which are allocated for use by each movement, and can be any integer from 0 to 10. Its default value is 0.

Notes

- Values for this command are automatically generated each time a new lane width is given on a WIDTHS command. The number of lanes generated is defined by the tens digit of the approach width (in feet). Approach widths of less than ten feet and greater than zero are assumed to have one lane. Thus, usage of the LANES command is necessary only for those lanes where this assumption of number of lanes is not appropriate.

Turning movements which turn from both exclusive turn lanes and shared through lanes should make use of the GROUPTYPES entry to define this condition which SIGNAL2000 calls dual optional lane usage

LEADLAGS 2*<Lead-Lag Phasing>

Defaults: 2*NONE
Menus/Groups: [PARAMETERS] [PHASING]

The purpose of this command is to enter the order of the phases, particularly in multiphase operation, of the current intersection.

<Lead-Lag Phasing> is a keyword which, in multi-phase operation, specifies whether the exclusive phase(s) (usually turning phase) precede(s) or follow(s) the through phase, and can be any of the following:

NONE	no exclusive turn phase(s) exist, or if they do, they will LEAD (default).
LEAD	exclusive turn phase(s) precede(s) the through phase.
LAG	exclusive turn phase(s) follow(s) the through phase.

Notes

- The first <Lead-Lag Phasing> is used for the north-south movements, the second for east-west movements.

- In split phase or lead-lag operation (SEQUENCE codes 7 and 8) NONE or LEAD indicates the north (east) movement precedes the south (west) movement. LAG indicates the south (west) precedes the north (east).

LEVELOFSERVICE	<Target Delay/LOS> <Target v/c>	<Max Delay/LOS> <Max v/c>	<Delay Incr> <v/c Incr>
Defaults:	35:C	80:E	5
	90	100	5
Menus/Groups:	[PARAMETERS] [INTERSECTION] [DESIGN]		

The purpose of this command is to enter the range of delay (or level of service) and v/c which should be tested by a DESIGN optimization and GOVERCS for the current intersection.

<Target Delay/LOS> is the desired or target delay (or level of service) of operation of the critical movements, and can be any integer delay from 0 to 300 seconds, or a level of service grade A, B, C, D, or E. Its default value is 35 seconds of delay (LOS C).

<Max Delay/LOS> is the worst amount of delay (or level of service) to be considered before a v/c optimization is attempted, and can be any integer delay from 0 to 300 seconds, or a level of service grade A, B, C, D, or E. Its default value is 80 seconds of delay (LOS E).

<Delay Incr> is the increment of delay which should be used to reach the <Max Delay/LOS> if the <Target Delay/LOS> cannot be achieved by a DESIGN, and can be any integer delay from 1 to 100 seconds. Its default value is 5 seconds.

<Target v/c> is the desired or target v/c of operation of the critical movements, and can be any integer v/c from 0 to 300 percent. Its default value is 90 percent (v/c = 0.90).

<Max v/c> is the worst amount of v/c to be considered before an optimization is abandoned and a solution is forced, and can be any integer v/c from 0 to 300 percent. Its default value is 100 percent (v/c = 1.00).

<v/c Incr> is the increment of v/c which should be used to reach the <Max v/c> if the <Target v/c> cannot be achieved by a DESIGN. Its default value is 5 percent.

Notes

- For DESIGN, the <Target Delay/LOS> entry of the LEVELOFSERVICE command sets the target delay (or level of service) which is to be achieved for all critical movements of the intersection. If this target level is achieved with excess time still available at the intersection, then the excess time is assigned to the phases according to the entries on the EXCESS command. If no EXCESS entries have been made, time is allocated proportionally to all phases. However, if EXCESS is used, this provides a means to designate a worst-case delay/LOS performance level for all critical movements and to assign all additional time to the priority movements of the EXCESS command. This is the preferred optimization scheme for the DESIGN function of SIGNAL2000 (see Appendix C for more details).

- The <Max Delay/LOS> must be a worse level or the same level as the <Target Delay/LOS>.

- If <Target Delay/LOS> is set to zero, any attempt to balance delays among the critical movements is skipped and the optimization starts with an attempt to meet the <Target v/c> value for all critical movements.

LOAD	**<Line Number>**	**<File Number>**	**<LOAD Type>**	**<# Blocks>**
Defaults:	next	next	PROCESS	-
Menus/Groups:	[DATAFILES]			

The purpose of this command is to input commands and parameters from permanent storage locations specified by the FILES command.

<Line Number> is the first line number in the specified file from which commands will be obtained, and can be any valid line number of the file less than or equal to 32767 (positive, negative or zero). Its default value is the "next line" of the file.

<File Number> is the order number of the desired file on the FILES command, and can be any integer from 1 to 5. Its default value is the "next file" in the file list.

<LOAD Type> is a keyword describing whether all commands from the file should be processed, or if some or all commands should be ignored, and can be any keyword described below.

PROCESS	process all commands (default).
SHARE	ignore unrecognized commands, e.g., share a data file from another program.
IGNORE	ignore all commands in the file up to the next RETURN, e.g., skip a data block.

<# Blocks> is the number of data blocks in the file which should be SHAREd or IGNOREd, and can be any positive integer from 1 to 999. Its default value is 1.

Notes

- Upon initiation of a LOAD command, commands will be obtained from the specified file starting at the specified line number and continuing with successive line numbers until a RETURN command is encountered. SAVE automatically places a RETURN command at the end of SAVEd information for future LOADs.

- The "next line" default is defined as the line number following the line of the file which was last accessed. This is usually the line number which follows the last information LOADed. When a FILES command is given, the "next line" for the specified file is automatically set equal to one. The "next line" can be changed by use of the NEXTLINES command.

- The "next file" default is defined as the file whose number is one greater than the file number currently in use. The keyboard should be considered file 0 for this purpose. Thus, the default file number for a LOAD from the keyboard is file #1. If a LOAD command is encountered in file #1, its "next file" default is file #2, etc.

- If <Line Number> is entered as 0, the LOAD will start at the "last line". The "last line" is defined as the last point in the file where file access was previously initiated. For example, LOAD 10 followed later by LOAD 0 will re-execute the LOAD 10, effectively a re-LOAD. LOAD 10 followed later by SAVE 0 will re-SAVE the LOADed parameters (see Chapter 5 of the *TEAPAC Tutorial/Reference Manual*).

- A negative <Line Number> of -n will start the LOAD at a point in the designated file n lines before the default "next line" of the file - i.e., LOAD -5 will start the LOAD five lines prior to the current "next line" of the file.

- The SHARE/IGNORE option is only in effect during the LOAD where the option was used (do not use embedded LOADs with the SHARE option). Use of the SHARE option not only ignores commands which it does not recognize, but also ignores any RESET commands encountered during the current LOAD. It is used to share files created by other programs. IGNORE ignores all commands in the file up to the next RETURN command.

- SHARE is automatic when the program detects a data file from a different TEAPAC program, or is unable to determine the source of the data file.

- The <# Blocks> indicates how many successive LOADs should be done, using the current SHARE or IGNORE option, as a result of the single LOAD command that was issued. This option does not apply to the PROCESS keyword.

MAP --

Defaults:	--
Menus/Groups:	[RESULTS] [ANALYZE]

The purpose of this command is to display a schematic map of the intersection identifying the twelve turning movement volumes as well as widths and lanes for the current intersection or all intersections. It has no parameters.

Notes

- The schematic display also includes the phasing and related parameters defined for the intersection.

MASTERNODE <Master Node #>

Defaults: 0
Menus/Groups: [PARAMETERS] [SYSTEM]

The purpose of this command is to enter the node number of the intersection which is the master node location for the system or subsystem.

<Master Node #> is the node number of the intersection which acts as the master location for the system, and can be any valid node number from 0 to 999. Its default value is 0, no master node defined.

Notes

- The system cycle length for coordinated systems will be equal to <Minimum Cycle> for the intersection referenced by MASTERNODE. If MASTERNODE is 0, <Minimum Cycle> for the first node in the NODELIST will be used as the system cycle.

- The node number entered need not be the actual location of the master controller. This entry simply indicates that the offset which is entered for the master intersection will not be changed by TRANSYT or PASSER during the optimization process.

- If the node number given is not included in the current NODELIST/SUBSYSTEM, the master node input for TRANSYT or PASSER will be omitted to prevent an error in the TRANSYT and PASSER runs.

MESSAGES <Level of Messages>

Defaults: 3
Menus/Groups: [INFO]

The purpose of this command is to display messages concerning changes made to the program since the last printing of the tutorial/reference manual.

<Level of Messages> is the level of detail desired for the update messages, and can be any integer from 0 to 3, as described below.

0 display only the current version/level of the program.
1 display a summary of changes made in the last revision of the program.
2 display detailed discussions of each change made in the last revision of the program.
3 display detailed discussions of all recent revisions to the program (default).

Notes

- The Help-RecentChanges menu uses message level 3 by default. The Manual Mode must be used for any of the other options.

- Messages concerning changes, bugs, fixes, etc., in the program will be displayed. For option 3, the version/level number and date of each revision of the program will be displayed at the start of each message listing. For this option, different version/levels of the program are listed in reverse chronological order, with the most current version first.

- All messages for versions of the program after the version shown on the title page of the tutorial/reference manual should be printed and inserted in Appendix H of the manual as addenda to the manual. These changes will not be referenced anywhere in that release of the manual.

METROAREA <Location>

Defaults: NON-CBD
Menus/Groups: [PARAMETERS] [BASIC] [INTERSECTION]

The purpose of this command is to enter the location of the intersection within the metropolitan area of the current intersection.

<Location> is a keyword describing the location of the intersection within the metropolitan area, and can be any of the following:

CBD	central business district.
NON-CBD	any area other than CBD (default).

Notes

- Entry of any keyword other than CBD will generate a NON-CBD entry, since this is the only area location distinction made by the 2000 *Highway Capacity Manual* computations. The other keywords are allowed for compatibility with previous versions of SIGNAL2000 (SIGNAL97, SIGNAL94, SIGNAL85 and SIGNAL). Only the CBD and NON-CBD keywords are SAVEd in a data file.

MINIMUMS 12*<Minimum Green Time>

Defaults: 12*5.0
Menus/Groups: [PARAMETERS] [BASIC] [MOVEMENT] [DESIGN]

The purpose of this command is to enter the minimum green time requirements for each of the twelve movements of the current intersection.

<Minimum Green Time> is the number of seconds which, as a minimum, must be received by the movement in order to satisfy requirements of safety and driver reaction, and can be any number from 0 to 99.9. Its default value is 5.0.

Notes

- This command is useful in establishing minimum pedestrian crossing times, as well as operational minimums. To consider a minimum pedestrian constraint, usually setting the minimum green time for the adjacent through movement will properly constrain the optimum timings. For example, pedestrians crossing the east leg would typically use the same green time as the through movement on the south approach, so the minimum of the south through movement should be set to consider these pedestrians.

- Yellow and all-red clearance times should not be included in the <Minimum Green Time> entries.

MOVLABELS 12*<Movement Label>

Defaults: 4*(RT TH LT)
Menus/Groups: [PARAMETERS] [BASIC] [MOVEMENT]

The purpose of this command is to enter abbreviated labels for each movement of the current intersection.

<Movement Label> is a two-character abbreviation used to identify each of the twelve movements at the intersection, and can be any pair of printable characters. Its default value is RT, TH, LT, for the right turns, throughs, and left turns of each approach, respectively.

Notes

- Use of MOVLABELS does not change the order of entry -- this order is always clockwise starting with the north approach. MOVLABELS merely allows each movement to be labeled with the user's choice of characters.

NETWORK **<Direction> <Distance> <Speed> <Node #> 4*<Movement #> <Assignment Method> <Curvature> <Manual Distance>**

Defaults:	--	0	0	0	4*0
	Default		None		
Menus/Groups:	[PARAMETERS] [INTERSECTION]				

The purpose of this command is to enter the current intersection's relative location in the system network, including spatial and speed parameters.

<Direction> is the approach to the intersection for which the following data applies, and can be NORTH, EAST, SOUTH, or WEST. There is no default value for this parameter, it must be entered.

<Distance> is the distance, in feet, from the closest upstream node for the approach specified, and can be any number from 0 to 32000. Its default value is 0.

<Speed> is the travel speed, in miles per hour, approaching the node for the approach specified, and can be any number from 0 to 65. Its default value is 0.

<Node #> is the upstream node number for the approach specified, and can be any node number defined in the system and usually, but not necessarily, in the specified node list, from 0 to 999. Its default value is 0.

<Movement #> is the movement number at the specified upstream node which provides traffic flow to the subject intersection, and can be 0 or 1-12. Its default value is 0 (see discussion below).

<Assignment Method> is the method to be used to assign upstream volumes to downstream links, and can be DEFAULT, FULL or LIMITED. Its default value is DEFAULT.

<Curvature> is curvature of the link from the perspective of the driver approaching the intersection, and can be NONE, RIGHT or LEFT. Its default value is NONE.

<Manual Distance> is a flag which identifies if the upstream distance above has been entered manually and is intentionally inconsistent with the network scale, and can be NO or YES. Its default value is NO.

Notes

- This is one of several entries (including NODELIST, SUBSYSTEM, INTERSECTION, NODELOCATION and NETWORK) which can be made or might be altered when using the drag-and-drop network creation/editing functions in the main window. Entries made from a dialog will change the values created in the main window, and vice-versa.

- This command is included primarily for data file compatibility with other TEAPAC programs. However, if approach speeds are included, EVALUATE will calculate approximate fuel consumption and CO emissions for acceleration, deceleration and idle conditions. Further, if distances are included, fuel and CO are calculated for link travel as well.

- If no <Movement #> is entered, movement numbers are calculated when needed assuming a rectangular network relationship. That is, if no <Movement #> is entered for the north approach, the movement numbers of the upstream node which are assumed to feed the downstream node are 2, 6 and 10.

- <Assignment Method> and <Curvature> are not used by SIGNAL2000. Their presence provides direct compatibility with PRETRANSYT and PRENETSIM.

- If <Manual Distance> is set to YES, the upstream distance for this link will be excluded from the calculation of the avergage network scale factor, as well as any checks for consistency between the link's apparent scale factor (based on its endpoint coordinates) and the rest of the network. A value of NO is recommended, but if an upstream distance is intentionally inconsistent with the coordinate values and real network scale factor, YES should be used to prevent that condition from improperly affecting the calculation of the average network scale factor and related contingency checks for network connections which are made.

NEWPAGE <Page Advance Option>

Defaults: YES
Menus/Groups: [CONTROL]

The purpose of this command is to enter a flag indicating that the next output report should begin with title headings at the top of the next page.

<Page Advance Option> is a keyword identifying whether or not the next report should be forced onto the next page of output even if it will fit on the remaining portion of the current page, and can be either of the keywords described below.

NO	do not force a new page with the next report.
YES	advance to a new page with the next report output (default).

Notes

- If the page length is set to zero with IODEVICES, titles will be printed at the current page location without a page advance (continuous printing). Use of NEWPAGE is primarily oriented towards the batch mode, using control files.

- In the batch mode, if a report is too large to fit on the remaining portion of the designated report length on the current page (as designated on the IODEVICES command), it will be placed on a new page regardless of the condition specified by the NEWPAGE command.

- If the first command to reset on the RESET command is [PARAMETERS], a NEWPAGE YES command is automatically invoked. Thus, any report produced following a RESET command will be forced to the top of the next page. This feature can be defeated by use of a NEWPAGE NO following the RESET command.

NEXTLINES 5*<Next Line of File>

Defaults: 5*next
Menus/Groups: [DATAFILES]

The purpose of this command is to enter the default next line to be accessed in each of the five files.

<Next Line of File> is the line number of the default next line to be accessed in the file, and can be zero or any positive number less than or equal to the last line of the file and less than or equal to 32767. Its default value is the line number after the last line accessed for each file.

Notes

- The "next line" of a file is automatically set each time a RETURN command is encountered in a file. In this case, the "next line" of that file is set to the line number of the line which follows the RETURN command.

- The "next line" of a file is automatically set to 1 each time a file is opened with the FILES command.

- This command is particularly useful to initialize repeated execution of sets of commands which use the default value of <Line Number> for the LOAD command.

NODELIST 500*<Node Number>

Defaults: -
Menus/Groups: [PARAMETERS] [BASIC] [SYSTEM]

The purpose of this command is to enter the list of nodes to be studied, as well as the order of the analysis.

<Node Number> is a unique number assigned to each intersection on the INTERSECTION command, and can be any integer from 0 to 999. Its default value is 0, and thus must be entered.

Notes

- This is one of several entries (including NODELIST, SUBSYSTEM, INTERSECTION, NODELOCATION and NETWORK) which can be made or might be altered when using the drag-and-drop network creation/editing functions in the main window. Entries made from a dialog will change the values created in the main window, and vice-versa.

- The order that the nodes are specified in the NODELIST is the order they are analyzed when INTERSECTION 0 is selected for all intersections.

- If SIGNAL2000 data will be used by PRETRANSYT, node numbers cannot exceed the value of 327, since all node numbers will be multiplied by 100 when link numbers are created for TRANSYT and link numbers greater than 32767 cannot be created due to internal arithmetic limitations. When using Release 6 or higher of TRANSYT7F and modeling permitted left turns, either with exclusive-permissive phases or permitted-only phases, TRANSYT requires that the permitted movement link number be input as a negative number. Since only five columns are allowed for the input, the negative sign leaves four columns for the link number, thus node numbers less than 100 are recommended. 99 is the limit for TRANSYT Release 9.

- In Uage Level 1 and 2 versions of SIGNAL2000. the NODELIST can only be 12 nodes in length. In Usage Level 3 versions, the NODELIST can be as many as 100 nodes in length, and in Usage Level 4 versions, the NODELIST can be as many as 500 nodes in length.

- When in the Visual Mode or using the ASK command to enter the NODELIST, the actual list can be enetered only once. After this entry, the list must be modified one intersection at a time with the edit buttons of the NODELIST dialog. When entering the NODELIST this first time, type no more than 80 characters per entry, using ampersands (&) to continue long entries to subsequent entry lines.

NODELOCATION <X-Y Coordinates>

Defaults: 0, 0
Menus/Groups: [PARAMETERS] [INTERSECTION]

The purpose of this command is to enter the X and Y coordinates of the current intersection.

<X-Y Coordinates> is the X and Y coordinates of the intersection, and can be any common coordinate system value, as integers from -2,147,483,647 to 2,147,483,647. Its default value is 0, 0.

Notes

- This is one of several entries (including NODELIST, SUBSYSTEM, INTERSECTION, NODELOCATION and NETWORK) which can be made or might be altered when using the drag-and-drop network creation/editing functions in the main window. Entries made from a dialog will change the values created in the main window, and vice-versa.

- This input has no effect on SIGNAL2000 calculations, but appears for compatibility with other TEAPAC programs such as SITE which display schematic network diagrams on-screen and PRENETSIM for NETSIM/CORSIM animation.

NOTE <Third Title Line>

Defaults: 80 blanks
Menus/Groups: [TITLES]

The purpose of this command is to enter the third line of information contained in the title of each report.

<Third Title Line> is the third of three lines of information, generally used to note further conditions identifying the situation being analyzed, displayed at the top of every output report., and can be up to 80 characters of information. Its default value is 80 blanks.

Notes

- If the first character of the NOTE parameter is a plus sign, "+", the characters entered on this command will be overlaid over those of the previously entered NOTE command. This overlay will begin at the character position identified by the digits of the first two characters which follow the "+", and will end after the last non-blank character which is entered. See Chapter 5 of the *TEAPAC Tutorial/Reference Manual* for further explanation and examples of this feature.

- Entries on this command may be enclosed in 'single quotes' or "double quotes". This option provides the capability to include leading blanks in the entry, which is otherwise not possible. This option can also be used to enter a single blank as the title line using a ' ' or " " entry, thereby blanking out the entire prior contents of the title line.

- The name of the current open file can be inserted anywhere in the title line by placing %F at the desired location of the title line. The file name can be placed at a specific column location in a title line by using the +XX form of a title entry noted above.

NSTOPFACTORS 12*<Stops Adjustment Factor>

Defaults: 12*1.00
Menus/Groups: [PARAMETERS] [MOVEMENT]

The purpose of this command is to enter twelve factors for the current intersection used to adjust the number of stops calculations of the EVALUATE report, for example, to match the number of stops obtained from a network simulation model.

<Stops Adjustment Factor> is the factor to adjust number of stops calculated for each movement, and can be any number from 0.01 to 9.99. Its default value is 1.00, no adjustment.

Notes

- If number of stops have been simulated with a network model such as TRANSYT-7F or NETSIM/CORSIM which does a better job of modeling delay between coordinated signals than the 2000 *Highway Capacity Manual* allows, NSTOPFACTORS may be used to force the calculations of number of stops in EVALUATE to the same values. For example, if EVALUATE calculates 20 stops, but TRANSYT-7F estimates 16 stops, use an NSTOPFACTOR of 0.80.

OFFSET	**<Offset>**	**<Phase Number>**
Defaults:	0.00	0
Menus/Groups:	[PARAMETERS]	[PHASING]

The purpose of this command is to enter the coordinated offset for a phase of the phase sequence of the current intersection.

<Offset> is the coordinated offset in seconds or seconds/second, and can be zero, or any positive number less than or equal to 900. Its default value is 0.00.

<Phase Number> is the phase for which the offset is specified, and can be 1-6. Its default value is 1.

Notes

- An offset greater than or equal to 1.0 is assumed to be in seconds; less than 1.0 is assumed to be in seconds/second.
- If a signal is to be double-cycled the OFFSET must be entered in seconds (not sec/sec).
- The offset is included in the capacity analysis summary and performance evaluation reports of ANALYZE and EVALUATE, respectively, in order to provide a complete record of all timings at an intersection. The offsets are calculated for all phases with the data provided by OFFSET.

OPTIMIZE	**<Optimization Type>**	**<Step Size List>**
Defaults:	NONE	15*0
Menus/Groups:	[PARAMETERS] [SYSTEM]	

The purpose of this command is to enter the type of system optimization to be performed by TRANSYT or PASSER.

<Optimization Type> defines the values that are to be optimized by TRANSYT or PASSER, and can be any of the following keywords:

NONE	No optimization, only a simulation of input (default).
OFFSETS	Optimize offsets only.
SPLITS+OFFSETS	Optimizes splits and offsets.
CYCLE+SPL+OFF	Optimizes cycle, split and offset.
LIST	Allows user to specify the step sizes used in the hillclimb optimizing process.

<Step Size List> defines up to 15 step sizes to be used by TRANSYT when the LIST option is selected above, or defines the DI, PI, PROS/DI, optimization type and multi-cycle options of card type 5x when LIST is not selected. It can be any valid step sizes or option values for the TRANSYT model, from -3 to 99. Its default value is 0 0 0 2 0 which assumes the LIST option is not selected.

Notes

- If CYCLE optimization is selected for TRANSYT or PASSER, the CYCLES command must also specify a cycle range with more than one cycle.

- If the LIST option of OPTIMIZE is not used, then the first three step size values input are used to designate the 2nd, 3rd and 4th fields of the 5X card. These are, respectively, the definition of the disutility index (DI), the definition of the performance index (PI), and the relative weight of PROS for the PROS/DI performance index. The default values of 0 for these fields perform the normal minimization of delay and stops, but these entries can be used to conduct other optimizations, with the PROS model being the one of greatest interest.

- If the LIST option of OPTIMIZE is not used, then the fourth step size value input is used to designate the 8th field of the 5X card, the optimization algorithm -- 2 for Hillclimb, 1 for Genetic non-elitist, and 0 for Genetic elitist.

- If the LIST option of OPTIMIZE is not used, then the fifth step size value input is used to designate whether a single-cycle (0) or multi-cycle (1) simulation will be performed, as defined by the X-value of the 5X card. If multi-cycle is selected, step-wise simulation will be forced.

- If LIST is used, then when a zero value is entered as a step size anywhere except the first field, this will zero out the remainder of the step size list.

OUTPUT	**<Prog>**	**<Worksheets>**	**<Messages>**
	<Design/Evaluate>		
Defaults:	SIGNAL2000	NONE	YES
	NONE		
Menus/Groups:	[PARAMETERS] [SYSTEM] [ANALYZE] [DESIGN]		

The purpose of this command is to enter flags regarding whether or not to display ANALYZE/EVALUATE/QUEUECALCS worksheets, warning messages and additional DESIGN/EVALUATE information.

<Prog> is the TEAPAC program for which the OUTPUT values are to be provided, and can be any valid TEAPAC program name. Its default value is SIGNAL2000.

<Worksheets> is a keyword which identifies which, if any, capacity analysis worksheets should be displayed, and can be any of the following:

NONE - No HCM worksheet display (default).
BASIC - Display only basic HCM worksheets.
FULL - Display all HCM worksheets (same as YES).

<Messages> is a keyword which identifies whether or not messages such as excessive turning movement percentages in through lanes should be displayed, and can be any of the following:

NO - No warning message output.
YES - Warning message output (default).

<Design/Evaluate> is a keyword which identifies whether or not additional output regarding the operational design of each sequence or evaluation should be displayed, and can be any of the following:

NONE - No additional DESIGN or EVALUATE output (default).
DETAIL - Detailed DESIGN output for each combination of cycle & sequence.
EXTRA - Additional DESIGN or EVALUATE output (not recommended).

Notes

- Capacity Analysis Worksheets which match those of the 2000 *Highway Capacity Manual* can be produced any time the ANALYZE, EVALUATE and QUEUECALCS commands are used. This option is selected with the <Worksheets> parameter.

- Certain warning messages can be suppressed with the NO option for the <Messages> flag. For example, each time turning movement percentages in through lanes are determined to exceed 50% of all volumes in that stream, a message to that effect is displayed.

- When requesting EXTRA output regarding the DESIGN of each phase sequence using the <Design/Evaluate> option, it is suggested that a minimal number of cycles be tested. This is due to the fact that a considerable amount of output is generated for each cycle length tested. The output generated from this selection is self-evident and not documented anywhere, and is not generally recommended.

OVERLAPS 4*<Right Turn Overlap>

Defaults: 4*YES
Menus/Groups: [PARAMETERS] [PHASING]

The purpose of this command is to enter how right turn overlaps are to be handled for each approach of the current intersection.

<Right Turn Overlap> is a keyword which describes whether right turns will be added to the standard phasings in overlap phases where exclusive right turn lanes exist, and can be any of the following:

NO	don't allow right turn overlap under any condition.
YES	allow right turn overlap into adjacent phases if an exclusive right turn lane exists (default).

Notes

- The default is YES for each right turn, meaning that if an exclusive right turn lane exists and the phasing would allow a non-conflicting overlap to be added as an extension of the normal right turn indication, it will be added. The extension will be to an adjacent phase only. The other option, NO, will prevent the addition of a right turn in an overlap phase, regardless of the turn lane or phasing conditions.

- Note that some controllers may allow a right turn overlap to be used in the field where the overlap phase is not adjacent to the normal right turn indication (through phase), but that the fundamental assumptions of the delay formulation in the 2000 *Highway Capacity Manual* do not permit the calculations of delays for movements with two distinct green indications each cycle (with the single exception of compound left turn phasing - see PERMISSIVES), so this is not allowed in SIGNAL2000.

PARKINGSIDES 4*<Parking Location>

Defaults:	4*NONE
Menus/Groups:	[PARAMETERS] [BASIC] [APPROACH]

The purpose of this command is to enter parking conditions on each approach of the current intersection.

<Parking Location> is a keyword which describes, from the driver's point of view, the parking conditions on the approach, and can be any of the following:

NONE	- no parking (default).
LEFT	- parking on the left side.
RIGHT	- parking on the right side.
BOTH	- parking on both sides.

Notes

- PARKVOLUMES must be used in conjunction with PARKINGSIDES to define the number of parking maneuvers each hour. The default PARKVOLUMES is 20, but if PARKINGSIDES is NONE, PARKVOLUMES is ignored.

- Parking conditions only apply to the lane group to which they are adjacent.

PARKVOLUMES 4*<Parking Volume>

Defaults: 4*20
Menus/Groups: [PARAMETERS] [BASIC] [APPROACH]

The purpose of this command is to enter the number of parking maneuvers per hour on each side of each approach of the current intersection.

<Parking Volume> is the number of parking maneuvers per hour, and can be any integer from 0 to 180. Its default value is 20.

Notes

- PARKVOLUMES must be used in conjunction with PARKINGSIDES to define the number of parking maneuvers each hour. The number entered is for one side of the approach only. If parking exists on both sides of a 1-way approach, the average number of maneuvers on each side should be entered. If one lane group is adjacent to both sides of parking, the number entered will be doubled to calculate the parking adjustment factor.

- The default PARKVOLUMES is 20, but if PARKINGSIDES is NONE, PARKVOLUMES is ignored.

PATHASSIGNMENT	**<Path #>**	**<Path %>**	**<Path List>**
Defaults:	0	0	8*0
Menus/Groups:	[PARAMETERS] [SITE]		

The purpose of this command is to enter a path (list of intersections) which vehicles of the current distribution type follow when traveling to and from the development.

<Path #> is the path number which determines which of the four possible paths is to be defined for the current distribution type, and can be 1-5 - a selected path number. It has no default value; it must be entered.

<Path %> is the percentage of total trips generated for the current distribution type which is to be assigned to the following path, and can be 0 - 100 percent. Its default value is 0.

<Path List> is a list of intersection node numbers, separated by spaces, through which vehicles generated by the site for the current distribution type, in the order they occur in the path, and not to exceed 16 intersections in length. Each entry can be any valid intersection number (see note below). Its default value is 0; it must be entered.

Notes

- The first and last node numbers of the <Path List> must agree with the external node number of the current PATHDISTRIBUTION type and one of the access points of the GENERATION command. If the distribution type is an inbound type, the first node number must be the external node of the current distribution type and the last node number must be an inbound access node. If the distribution type is outbound, the reverse applies.

- Previously entered path lists on the PATHASSIGNMENT command can be deleted by entering a zero percentage for the list. This completely removes the list of intersections, which is readily apparent in the Visual Mode, and also ignores any list which may be entered following the zero percentage. This allows the removal of an unneeded list of intersections.

- If a previously entered PATHASSIGNMENT list must be shortened, the entry of node number 0 anywhere in the list will erase all nodes from that point to the end of the list. If the entire path is to be discarded, either replace it with a new path or use 0 percent so that the path is effectively ignored -- at this point an entire path cannot be eliminated from the PATHASSIGNMENT command.

- Intersection node numbers in <Path List> must match intersections previously established with the NODELIST command.

PATHDISTRIBUTION	**<Distr Type #>** **<Descr>**	**<Distr %>**	**<Node #>**	**<Node Dir>**
Defaults:	- 30-blanks	0	0	-
Menus/Groups:	[PARAMETERS] [SITE]			

The purpose of this command is to enter and set the current distribution type number, and enter its related distribution percentage, external node, and description.

<Distr Type #> is the number of the distribution type for which the following distribution information applies, and which will become the current distribution type #. It can be any integer from 0-150 (see note below). Its default value is 0; it must be entered.

<Distr %> is the percentage of total trips generated by the site which are distributed to this distribution type, and can be -100 to 100 percent. Its default value is 0; it must be entered.

<Node #> is the external node number through which all traffic for this distribution type enters or exits the study network, and can be 0-999 (see note below). Its default value is 0; it must be entered.

<Node Dir> is the approach of the external intersection which connects the study network to the external road network, and can be the keyword NORTH, EAST, SOUTH or WEST. It has no default value; it must be entered.

<Descr> is a set of words which describe what type of traffic is defined by this distribution type, usually including whether it is inbound or outbound traffic and which point of the compass or primary travel route the external point of the trips are destined, and can be any 30 alphabetic or numeric characters. Its default value is 30 blanks.

Notes

- The PATHDISTRIBUTION command must first be used to define the "current" distribution type before the PATHASSIGNMENT command can be used to describe travel paths for the "current" distribution type.

- All PATHDISTRIBUTIONs must be defined before the FINDPATHS command can be used to assist in the definition of PATHASSIGNMENTS.

- <Distribution Type #> must not exceed the limit previously established by the SITESIZE command, and <Node #> must be an intersection included in the current NODELIST command.

- In a Visual Mode dialog that includes PATHDISTRIBUTION or distribution type data, the "+" button, "-" button, ^Page-Up key and ^Page-Down key can be used to, in effect, dynamically issue a PATHDISTRIBUTION command for the next

and previous type numbers. If data values are changed on a screen display, the ^Page keys should not be used before the data is first entered with the TAB key.

PEAKHOURFACTORS 12*<Peak Hour Factor>

Defaults:	12*0.90
Menus/Groups:	[PARAMETERS] [BASIC] [MOVEMENT]

The purpose of this command is to enter the peak hour factor for each movement of the current intersection.

<Peak Hour Factor> is the peak hour factor for the movement, and can be in the range of 0.50 - 1.00. Its default value is 0.90.

Notes

- Peak hour factors are applied to the input demand volume to determine the "adjusted volume" for use in the saturation flow, v/c, and delay calculations. As such, caution should be used in arbitrarily applying peak hour factors much less than 0.90 since "adjusted volumes" substantially higher than the hourly volumes will be generated.

- Caution should be exercised in calculating peak hour factors from traffic counts, particularly on a movement-by-movement basis, since this calculation may not be statistically stable, especially for low volume movements. Further, use of movement-by-movement peak hour factors in the 2000 *Highway Capacity Manual* method suggests that all of the computed "adjusted volumes" occur at the same time, which is not likely the case.

- Entered demand VOLUMES will be adjusted by the entered PEAKHOURFACTORS as a means of estimating the peak flow rate during the analysis period. When the analysis period is the default of 15 minutes (0.25 hours), this means that an entered volume divided by the peak hour factor will estimate the flow rate during the peak 15 minute analysis period for each movement. If 15-minute data is available directly (e.g., from count data), using this 15-minute data (the 15-minute count times 4) with peak hour factors of 1.00 is preferred over making the approximation using a peak hour factor. In particular, if different peak hour factor data is entered for each individual movement, the estimate will likely produce a ficticious set of analysis flow rates which may represent flow conditions which never occur since all the movements may not peak at the same time.

PEDLEVELS 4*<Pedestrian Interference>

Defaults: 4*0
Menus/Groups: [PARAMETERS] [APPROACH] [94DEFAULTS]

The purpose of this command is to enter the level of pedestrian interference for right turns on each approach of the current intersection.

<Pedestrian Interference> is the volume of conflicting pedestrians, in peds per hour, for right turns on the approach, and can be any integer from 0 to 5000. Its default value is 0.

Notes

- Entries for pedestrian interference should be made for the approach from which the conflicting right turn is made. For example, pedestrians crossing the east leg of the intersection interfere with right turns made from the south approach, so the <Pedestrian Interference> value for that right turn should be input for the south approach.

- Under certain phasing conditions, pedestrian interference can also affect the left turns coming from the opposite approach than the right turns described in note 1. above. For example, pedestrians crossing the east leg of the intersection may also interfere with left turns made from the north approach. The <Pedestrian Interference> value for this left turn should be input for the opposite (south) approach as in the case of the right turns in note 1. above.

- Versions of the SIGNAL/TEAPAC program prior to SIGNAL2000 (SIGNAL97, SIGNAL94, etc.) permitted the use of certain keywords to represent typical ped volume conditions. To permit upwards-compatibility of data files from these earlier programs, SIGNAL2000 will convert these keywords in the same manner as the earlier programs using the following relationships between the number of conflicting pedestrians and the keyword used: LOW=50, MODERATE=200 and HIGH=400. These numeric values will be the values saved if this data is subsequently saved by SIGNAL2000.

- If an exclusive pedestrian phase is defined with the PEDTIME entry, PEDLEVELS should be set to zero since there should be no pedestrian interference with vehicular traffic during vehicle phases.

PEDTIME	**<Exclusive Pedestrian Phase Time>**	**<Phase Number>**
Defaults:	0.0	0
Menus/Groups:	[PARAMETER] [PHASING]	

The purpose of this command is to enter the time for an exclusive pedestrian scramble phase for the current intersection.

<Exclusive Pedestrian Phase Time> is the length of time in seconds to be allocated to an exclusive pedestrian phase (all red for vehicles), and can be any number from 0 to 900 and less than the cycle length for the phasing. Its default value is 0.0.

<Phase Number> is the number of the phase which the exclusive pedestrian phase follows, and can be any number from 0 to 6 and less than or equal to the number of phases in the sequence of operation. Its default value is 0 for no exclusive ped phase, or position in phasing is not important (placed at end of phasing).

Notes

- If an exclusive pedestrian phase is defined with the PEDTIME entry, PEDLEVELS should be set to zero since there should be no pedestrian interference with vehicular traffic during vehicle phases.

- PEDTIME can also be used to hold aside time for any sort of interruption in the cycle, not just a ped phase. For example, legs of the intersection not included in the four legs of the analysis or certain types of pre-emption.

PERIODS	**<Count Interval>**	**5*< <Start Time> <Stop Time> >**
Defaults:	15	5*<- ->
Menus/Groups:	[PARAMETERS] [TURNS/WARRANTS]	

The purpose of this command is to enter the count interval and the beginning and ending times for each count period for which subsequent data will be entered at the current intersection.

<Count Interval> is the interval, in minutes, between each count entry, and can be either 15 or 60 minutes. Its default value is 15 minutes.

<Start Time> is the time for each count period when the count was started, on a 24-hour clock, and can be any valid time between 0 - 2400 hours. It has no default value, and at least one <Start Time> must be entered.

<Stop Time> is the time for each count period when the count was stopped, on a 24-hour clock, and can be any valid time between 0 - 2400 hours. It has no default value , and at least one <Stop Time> must be entered.

Notes

- As many as five pairs of start and stop times can be given after the <Count Interval> for various periods which were counted during the same day.

- If counts are already reduced (e.g., not cumulative from interval to interval), one count will exist for each interval counted. For example, one hour of 15-minute counts will have four intervals, say with a start time of 1600 hours and an end time of 1645 hours. If counts are cumulative, an additional interval will exist for each period counted (e.g., 1600 to 1700 hours for the above example).

- All times are for the interval starting at the time stated. If reduced counts are being entered, these time entries are the start time of each interval counted. If cumulative counts are being entered, the times entered are the actual times each count number is recorded. For example, a cumulative count from 4:00 P.M. to 5:00 P.M. would record the first count at 1600, then again at 1615, 1630, 1645, and at the end of the count at 1700.

- If counts for a location are made on separate days, it is suggested that they be input and summarized as separate runs of the program, even if their time periods do not overlap. It is not possible to SUMMARISE, TABULATE, or ANALYZE overlapping time periods for different days; two runs are necessary.

- The PERIODS command values are used to set up the values of other commands such as VEHICLECOUNTS and TRUCKCOUNTS which will be accepted as input. As such, the PERIODS command is active and must be executed. This

sets up the new limits of the counts and opens up the required VEHICLECOUNTS and TRUCKCOUNTS commands in the full-screen displays.

- If <Start Time> and <Stop Time> values of zero are entered for a given time period, all subsequent time periods in the list are deleted.

PERMISSIVES 4*<Permissive Left>

Defaults: 4*NO
Menus/Groups: [PARAMETERS] [PHASING]

The purpose of this command is to enter an option for each approach of the current intersection identifying the permissability of left-turning traffic to turn on a through phase following or preceding an exclusive left turn phase (e.g. a protected-permitted left-turn or a permitted-protected left-turn, more recently referred to as compound left-turn phasing).

<Permissive Left> is a keyword which identifies whether or not left turns are allowed to turn on through phases following or preceding exclusive left turn phases (compound left-turn phasing), and can be any of the following:

NO - compound left-turn phasing not allowed (default).
YES - compound left-turn phasing allowed, but restricted to non-trap and single-lane turn lane conditions.
TRAPOK - compound left-turn phasing allowed, even in so-called ‘left-turn trap’ conditions which are otherwise considered unsafe, but not for multi-lane turn lane conditions.
MULTIOK - compound left-turn phasing allowed, even when the left turn lane consists of more than one lane (multi-lane), but not for left-turn trap conditions. Permitted left operations will also be allowed for multi-lane turn lanes in a single phase when this is selected.
UNRESTRICTED - compound left-turn phasing allowed under any conditions, including left-turn trap and multi-lane conditions.

Notes

- A left-turn trap is a condition where the through movement opposing a left turn continues moving after the left turn’s permitted phase ends, possibly leaving a left-turning vehicle stranded in the intersection facing a red indication, or causing the potentially stranded left-turner to think the opposing traffic phase is also ending and making the left turn directly into oncoming traffic. Selecting TRAPOK or UNRESTRICTED allows the program to set the phasing so such a trap condition exists, with the presumption that the analyst is satisfied that the otherwise unsafe condition will be handled safely on the street.

PHASEMOVEMENTS <Phase Number> <List of Movements>

Defaults:	--	0 0 0 0 0 0
Menus/Groups:	[PARAMETERS] [PHASING]	

The purpose of this command is to enter the movements permitted during each phase for a non-standard phasing for the current intersection.

<Phase Number> is the number of the phase within the sequence of phases for the following list of movements, and can be 0-6. There is no default for <Phase Number>, it must be entered.

<List of Movements> is the movement number occurring during the specified phase, and can be 0-12, -3, -6, -9 or -12. Its default value is 0.

Notes

- This is used for phasings that are not included in the standard sequence codes. SEQUENCES -1 through -9 must be used in order for PHASEMOVEMENTS entries to be recognized.

- Operational DESIGNS and EXPORTs cannot be performed for a sequence defined by the PHASEMOVEMENTS. Capacity Analysis and Evaluation can be performed with ANALYZE and EVALUATE, however, when data is presented in a proper manner.

- Movements must receive only one constant green indication during each cycle.

- All movements in a common direction, e.g., North-South, must appear in adjacent phases which do not overlap the beginning and end phases.

- Negative movement numbers should be used only to indicate permitted lefts following or preceding protected left phases. Negative movement numbers should not be used if the only phase the movement is allowed is permitted/opposed.

- The order of input of phases for PHASEMOVEMENTS is not important. The number of phases in the final phasing is determined by the last phase which has a non-zero number of movements in it. Extra phases can be eliminated by entering a movement number 0 as the first movement in the phase. This erases all following movement numbers for that phase and any phases which follow.

- The DIAGRAMS command can and should be used to review the phasing designated by PHASEMOVEMENTS before further analysis.

PROJECT <First Title Line>

Defaults: 80 blanks
Menus/Groups: [TITLES]

The purpose of this command is to enter the first line of information used to identify the situation being analyzed.

<First Title Line> is the first of three lines of information, generally used for the project name, displayed at the top of every output report, and can be up to 80 characters of alphabetic or numeric information. Its default value is 80 blanks.

Notes

- If the first character of the PROJECT parameter is a plus sign, "+", the characters entered on this command will be overlaid over those of the previously entered PROJECT command. This overlay will begin at the character position identified by the digits of the first two characters which follow the "+", and will end after the last non-blank character which is entered. See Chapter 5 of the *TEAPAC Tutorial/Reference Manual* for further explanation and examples of this feature.

- Entries on this command may be enclosed in 'single quotes' or "double quotes". This option provides the capability to include leading blanks in the entry, which is otherwise not possible. This option can also be used to enter a single blank as the title line using a ' ' or " " entry, thereby blanking out the entire prior contents of the title line.

- The name of the current open file can be inserted anywhere in the title line by placing %F at the desired location of the title line. The file name can be placed at a specific column location in a title line by using the +XX form of a title entry noted above.

QUEUECALCS --

Defaults: --
Menus/Groups: [RESULTS] [ANALYZE] [DESIGN]

The purpose of this command is to display a wide variety of various published queue calculations for a specified phasing and timings for the current intersection or all intersections, including the 2000 *Highway Capacity Manual* queue model. It has no parameters.

Notes

- The formulations for the various queue calculations are discussed in Appendix C. Queue model parameters are entered using the QUEUEMODELS command.

- Before this command can be properly executed, the phasing and timings must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES and CYCLE commands or the TIMINGS command.

QUEUEMODELS	**<Model #>**	**<Percentile>**	**<Auto>**	**<Truck>**
Defaults:	1	90	25	40
Menus/Groups:	[PARAMETERS] [SYSTEM]			

The purpose of this command is to enter parameters which control the queue model calculations used for all intersections under study.

<Model #> is the number of the preferred queue model as computed by the QUEUECALCS command, and can be any integer from 1 to 10, but not 2 or 5. Its default value is 1.

1 - HCM	2000 HCM, MBQ, Worst Lane. XXth Percentile Queue
3 - ARRB	ARRB, MBQ, Worst Lane, 95th Percentile Queue
4 - HCM	2000 HCM, MBQ, Worst Lane, Average Queue
6 - MBQ	Historical MBQ, Average Lane, Average Queue
7 - S97E+	SIGNAL97 Evaluate+, MQL, Average Lane, XXth Percentile Queue
8 - S97A+	SIGNAL97 Analyze+, MQL, Average Lane, XXth Percentile Queue
9 - S97E	SIGNAL97 Evaluate, MQL, Average Lane, 90th Percentile Queue
10 - S97A	SIGNAL97 Analyze, MQL, Average Lane, 90th Percentile Queue

<Percentile> is the percentile value desired to be estimated by the queue models, and can be any integer from 50 to 99. Its default value is 90.

<Auto> is the average queue spacing between front bumpers of queued automobiles, in feet, and can be any integer from 5 to 100. Its default value is 25.

<Truck> is the average queue spacing between front bumpers of queued trucks, in feet, and can be any integer from 5 to 100. Its default value is 40.

Notes

- The <Model #> defines the preferred queue model which will be used to calculate queues represented in the ANALYZE and EVALUATE results, as well as the bottom of the QUEUECALCS report.
- See Appendix C for a complete description of each of the queue models which can be computed by SIGNAL2000.
- All models do not support the calculation of any specified percentile value. For example, only a limited set of percentile values can be selected for the HCM model, the ARRB model always uses the 95th percentile, and the original SIGNAL97 models always uses the 90th percentile (see Appendix C).

- All models do not support the calculation of an entered length of autos and trucks. For example, the lengths of autos and trucks for the original SIGNAL97 models always use 25 and 40 feet, respectively (see Appendix C).

- Average lane Models 2 & 5 are no longer separately defined by the 2000 HCM.

REPEAT	**<Variable Name>**	**<First Val>**	**<Last Val>**	**<Increment>**
Defaults:	-	1	1	1
Menus/Groups:	[CONTROL]			

The purpose of this command is to initiate a loop in a control file so that the set of commands which follow will be repeated a finite number of times.

<Variable Name> is the name of the variable to be associated with the loop, and can be any character string beginning with a letter. It has no default value; a variable name must be provided.

<First Val> is the value which will be assigned to the loop variable the first time through the loop, and can be any integer from -32767 to 32767. Its default value is 1.

<Last Val> is the last value which the loop variable will be allowed to have in the loop, and can be any integer from -32767 to 32767. Its default value is 1.

<Increment> is the value which will be added to the loop variable for each pass of the loop in order to increment from <First Val> to <Last Val>, and can be any non-zero integer from -32767 to 32767. Its default value is 1.

Notes

- The end of a REPEAT loop is defined by a GOTO command which has <Variable Name> as its <Destination>.
- Although any character string is allowed as a variable name, only the first letter is used as the actual variable. All following non-blank characters are ignored. If another loop is currently active, its associated loop variable may not be used.
- A REPEAT loop will terminate when the value of the loop variable exceeds the specified <Last Val>. When a loop terminates, the loop variable will have the same value as <Last Val>.
- A negative value for <Increment> is allowed, in which case the loop variable will be decremented until it is less than <Last Val>.
- A limit of five REPEAT loops may be active at any one time (i.e., nested). Any number of sequential loops may be used (i.e., un-nested).
- See the detailed discussion of the various possible uses of the REPEAT loops and control files in Chapter 5 of the *TEAPAC Tutorial/Reference Manual*.

REQCLEARANCES 12*<Required Clearance>

Defaults:	12*4.0
Menus/Groups:	[PARAMETERS] [BASIC] [MOVEMENT] [DESIGN] [94DEFAULTS]

The purpose of this command is to enter the clearance times required for each movement of the current intersection.

<Required Clearance> is the clearance time required for each movement in seconds, and can be any number from 0 to 99.9. Its default value is 4.0.

Notes

- Required clearance times are used only by DESIGN to determine how much clearance time is needed to terminate each phase. This clearance time includes both yellow and all-red clearance. ANALYZE and EVALUATE use the clearance times specified on the YELLOWTIMES command, regardless of the values on REQCLEARANCES.

- It is important to make sure that YELLOWTIMES and REQCLEARANCES entries are always kept consistent with each other, especially when converting Timings by Phase to Timings by Movement and when exporting to third-party, ring-based software.

RESET <List of Commands>

Defaults: [PARAMETERS]
Menus/Groups: [DATAFILES]

The purpose of this command is to reset the parameters of the specified commands to their default values.

<List of Commands> is a set of commands and/or group names, and can be any valid commands or group names of the program. Its default value is [PARAMETERS] - all non-active commands for entry of parameters related to the analysis procedures.

Notes

- The File-New menu does a RESET for [ALL] commands.
- When a RESET [PARAMETERS] command is given, the NEWPAGE YES condition is automatically set. This can be subsequently disabled by the NEWPAGE NO command.
- RESET is not executed when it is encountered during a LOAD which uses the SHARE option.

RETURN --

Defaults: --
Menus/Groups: [CONTROL]

The purpose of this command is to return to the source of input which was being used when the last LOAD command was encountered. It has no parameters.

Notes

- The RETURN command will cause control (the source of input) to be changed from its current location (a file) to the source of the last LOAD command. If the last LOAD was from a file, control is given to the line which follows the LOAD command which caused a source change. If the previous LOAD command was read from the keyboard, control will return to the keyboard.

- If an end-of-file is encountered control is returned to the keyboard, in a similar fashion to a RETURN command. Control is always returned to the keyboard in these cases, however, as this is considered an abnormal condition.

RIGHTTURNONREDS 4*<Right Turn on Red Volume>

Defaults:	4*0
Menus/Groups:	[PARAMETERS] [APPROACH]

The purpose of this command is to enter the right turn on red volume for the right turns on each approach of the current intersection.

<Right Turn on Red Volume> is the volume, in vehicles per hour, of right turns being made on red, and can be any integer from 0 to 300. Its default value is 0.

Notes

- The volume entered will be used to reduce the right turn volume before any other adjustments are made, with the limitation that the right turn volume will never be reduced below 1 vph.

ROUND <Precision of Totals>

Defaults: 1
Menus/Groups: [PARAMETERS] [SITE]

The purpose of this command is to enter the precision to be used in computing the results.

<Precision of Totals> defines the precision of rounding of assignment totals for each intersection movement, and can be any integer from 1 to 1000. Its default value is 1.

Notes

- All computations are calculated to the nearest vehicle until the last computation is completed. At this point, the results for each intersection are rounded to the nearest whole multiple of the rounding precision entered on the ROUND command.

- If multiple computations are being CUMULATED by the COMPUTE command, successive rounding errors can be eliminated by making all the initial calculations and cumulations to the nearest 1 vehicle, except the last, which should be ROUNDed to the desired precision.

ROUTE <Route #> <List of Artery Nodes>

Defaults:	-	-
Menus/Groups:	[PARAMETERS]	[SYSTEM]

The purpose of this command is to enter a list of node numbers which represent the intersections on the artery for the given route number.

<Route #> is the number of the route which is defined by the following list of artery nodes, and can be any integer from 1 to 8. It has no default value and must be entered.

<List of Artery Nodes> is a list of up to 25 node numbers in the current NODELIST/SUBSYSTEM whose order defines the artery route. It can be any node number in the NODELIST/SUBSYSTEM from 0 to 999. It has no default value and must be entered.

Notes

- For TRANSYT, card types 42, 43 and 6X will be generated for all routes defined by the ROUTE command, only if the version of TRANSYT-7F being used is Release 7 or higher. If the route turns a corner, exclusive turning links are used, where applicable. The card type 43 produces weightings for each direction on each route based on the average movement volume (not link volume) in each direction on the routes. The left-to-right direction of the first route always gets a 100 percent weight, while the other direction and other routes get weightings in proportion to this base volume. The card types 60 and 61 which are produced request all possible post-analysis summaries of each route, including time-space diagrams, time-location diagrams, flow profiles, platoon-progression diagrams, etc.

- If ROUTE definition are to be used for TRANSYT, they must follow the specific rules presented in the TRANSYT manual regarding routes. For example, a route may be 1-way or 2-way, but may not be partially 1-way and partially 2-way. Many of these checks are performed by PRETRANSYT to validate the route definition, but not all possibilities are checked. The user must retain final responsibility for the proper definitions of routes.

- Route numbers can be referenced by use of negative numbers on the SUBSYSTEM command to quickly identify routes for analysis. For example, if ROUTE 1 is defined by an appropriate ROUTE command, a subsystem analysis for only this route can be created through the use of the SUBSYSTEM -1 command (this is only valid in Usage Level 3+ versions).

SATURATIONFLOWS 12*<Stream Saturation Flow>

Defaults: 12*0
Menus/Groups: [PARAMETERS] [MOVEMENT]

The purpose of this command is to store the results of saturation flow rate computations for the current intersection. When computational commands of the Analysis Mode like ANALYZE, EVALUATE, QUEUECALCS, GOVERCS and SERVICEVOLUMES are executed, the calculated saturation flows are dumped into this command.

<Stream Saturation Flow> is the stream saturation flow resulting from the execution of computational commands such as ANALYZE and SERVICEVOLUMES, and can be any integer from 0 to 9999. Its default value is 0.

Notes

- This command has no effect on any calculations. It is present only to receive values for output to a file in order to use these values in other TEAPAC programs, particularly PREPASSR, PRETRANSYT and PRENETSIM.

SAVE	**<Line Number>**	**<File Number>**	**<List of Commands>**
Defaults:	next	next	[PARAMETERS]
Menus/Groups:	[DATAFILES]		

The purpose of this command is to save the current parameter values of the listed commands in permanent storage locations specified by the FILES command, for future retrieval with the LOAD command.

<Line Number> is the line number in the file where the first command in the list is to be saved, and can be any valid line number of the file less than or equal to 32767 (positive, negative or zero). Its default value is the "next line" of the file.

<File Number> is the order number of the desired file on the FILES command, and can be any integer from 1 to 5. Its default value is the "next file" in the file list.

<List of Commands> is a set of commands and/or group names, and can be any valid commands or group names of the program. Its default value is [PARAMETERS] - all non-active commands for entry of parameters related to the analysis procedures.

Notes

- The "next line" default is defined as the line number following the line of the file which was last accessed. This is usually the line number which follows the last information LOADed or SAVEd. When a FILES command is given, the "next line" for the specified file is automatically set equal to one. The "next line" can be changed by use of the NEXTLINES command.

- The "next file" default is defined as the file whose number is one greater than the file number currently in use. The keyboard should be considered file 0 for this purpose. Thus, the default file number for a SAVE from the keyboard is file #1. If a SAVE command is encountered in file #1, its "next file" default is file #2, etc.

- If <Line Number> is entered as 0, the SAVE will start at the "last line". The "last line" is defined as the last point in the file where file access was previously initiated. For example, LOAD 10 followed later by SAVE 0 will "re-SAVE" the information LOADed at line 10 (see Chapter 5 of the *TEAPAC Tutorial/Reference Manual*).

- SAVE will always put a RETURN command into the file after the last command of the list for subsequent LOADs.

- If the first parameter in <List of Commands> is [PARAMETERS], then PROJECT, DESCRIPTION, NOTE, and RESET will be saved in the file at the

specified line number, before the <List of Commands> and RETURN is saved. This is the case when the default condition is used.

- A negative <Line Number> of -n will start the SAVE at a point in the designated file n lines before the default "next line" of the file - i.e., SAVE -5 will start the SAVE five lines prior to the current "next line" of the file. Thus, SAVE -1 will SAVE <List of Commands> on top of the previously saved RETURN command, effectively appending the newly SAVEd information to the end of the previously SAVEd information.

SEQUENCES <Sequence Code> <List of Possible Sequence Codes>

Defaults:	11	ALL
Menus/Groups:	[PARAMETERS] [BASIC] [PHASING] [ANALYZE] [DESIGN]	

The purpose of this command is to enter the desired and allowed phasings of the traffic signal of the current intersection according to the codes defined in Figure 1-2 of Chapter 1.

<Sequence Code> is a sequence code which represents the desired phasing, and can be any valid two-digit code, or -1 through -9. Its default value is 11 - two-phase operation.

<List of Possible Sequence Codes> is a list of two-character sequence codes which represent the possible phasings which are allowed, each of which can be any valid two-digit code, a two-character abbreviation for a list of codes, or ALL. Its default value is ALL - all possible sequence codes.

Notes

- A LEADLAGS entry can be used in addition to the SEQUENCES entry for phasings which are not in the same order as shown on the code sheet. Use PERMISSIVES to add permitted left turns before or after protected left turn phases. Use OVERLAPS OVERLAPS to designate right turn overlaps.

- Special abbreviation characters A-D can be used in place of codes 1-8 as shortcuts to represent common lists of phasing possibilities, as noted below:
  A represents codes 1-8
  B represents codes 1-6
  C represents codes 4-6
  D represents codes 7-8
  Thus, a list of 14 15 16 could be entered as a single code 1C, and a list of 11 21 31 41 51 61 could be entered as simply B1. Use DIAGRAMS * to view all the SEQUENCES listed for a given abbreviation made here.

- The use of SEQUENCES -1 through -9 requires use of PHASEMOVEMENTS to identify the movements for each phase, in which case DESIGN and EXPORT cannot be used.

- SORT and TIMINGS re-arrange the <List of Possible Sequence Codes> so that the best or selected sequence code, respectively, is first, thus appearing as the <Sequence Code> entry. After TIMINGS, this makes the selected sequence code which goes with the phase timings available for a subsequent ANALYZE-type functions, as well as for programs such as PREPASSR, PRETRANSYT and PRENETSIM which require a single phasing and set of timings.

SERVICEVOLUMES --

Defaults:	--
Menus/Groups:	[RESULTS] [ANALYZE]

The purpose of this command is to compute the saturation flow rate (previously called service volumes) for each movement for the current intersection or all intersections. It has no parameters.

Notes

- The computed saturation flow rates are in vehicles per hour of green time with 100% greentime assumed.

- When the SERVICEVOLUMES command is executed, the calculated saturation flows are entered into the SATURATIONFLOWS command automatically. Subsequent to this action, the SATURATIONFLOWS can be SAVEd in a data file for use by other programs such as PREPASSR, PRETRANSYT and PRENETSIM.

- Before this command can be properly executed, the phasing and timings must have been previously set. This can be accomplished through use of the SEQUENCES, GREENTIMES, YELLOWTIMES and CYCLE commands or the TIMINGS command.

SIMULATION **<Steps/Cycle> <Analysis Period> <Stop Penalty> <Link Numbering Method> <Model Actuated> <Assignment Method>**

Defaults:	300	15		-1
	TEAPAC		NO	
	Full			
Menus/Groups:	[PARAMETERS] [SYSTEM]			

The purpose of this command is to enter simulation control parameters, including the length of the analysis period for all intersections under study.

<Steps/Cycle> is the number of increments each cycle will be divided into in the TRANSYT simulation, and can be any value from -300 to 300. The absolute value of the input is the number of steps per cycle. If the value is negative a step-wise simulation is performed; otherwise a standard link-wise simulation is performed. Its default value is 300. It is used by PRETRANSYT only.

<Analysis Period> is the length of the analysis period in minutes, and can be any integer from -999 to 9999. Its default value is 15. It may also be entered as a negative number whose positive value is the number of cycle lengths which define the analysis period.

<Stop Penalty> is the stop penalty to be used in calculating the performance index of the TRANSYT simulation, and can be any value from -1 to 9999. Its default value is -1 to minimize fuel consumption. It is used by PRETRANSYT only.

<Link Numbering Method> is a keyword which describes which link numbering method will be used when creating links for TRANSYT, and can be any of the three following keywords:

TEAPAC	links will be numbered using TEAPAC's normal numbering scheme, counting clockwise around the intersection starting with the right turn on the north approach (default).
TRANSYT	links will be numbered using the scheme described in the TRANSYT-7F user manual.
NEMA	links will be numbered using the alternate NEMA scheme described in the TRANSYT-7F user manual.

<Model Actuated> is a keyword which describes whether the TRANSYT or PASSER actuated model should be used for actuated movements, and can be NO or YES. Its default is NO. It is used by PRETRANSYT and PREPASSR only.

<Assignment Method> is the default method to be used to assign upstream volumes to downstream links if not specified on a NETWORK entry, and can be FULL or LIMITED. Its default value is FULL. It is used by PRETRANSYT only.

Notes

- If the analysis period is anything other than the default of 15 minutes, VOLUMES should be entered as the flow rates in vehicles per hour during this period and PEAKHOURFACTORS should be entered as 1.0.

SITESIZE **<# of Distribution Types>** **<# of Inbound Types>**

Defaults:	0	0
Menus/Groups:	[PARAMETERS] [SITE]	

The purpose of this command is to enter the number of distribution types to be used to describe the inbound and outbound traffic generation.

<# of Distribution Types> is the total number of inbound and outbound distribution types which will be used to define the distribution of trips generated into and out of the site, and can be any integer from 0-150 (see note below). Its default value is 0; it must be entered before any distribution information can be entered.

<# of Inbound Types> is how many of the total distribution types are to be used to define those trips which are destined for the site. These will be the first of the total distribution types, the remainder of which will be declared outbound types. It can be any integer from 0-150, and less than or equal to the <# of Distribution Types>. Its default value is 0.

Notes

- The SITESIZE command must be virtually the first command entered when defining a study network and generator, since no [GENERATOR] or [ASSIGNMENT] commands can be entered until the SITESIZE of the study is defined.

- The maximum size of the study depends on the licensed Usage Level of the program. Usage Levels 1 and 2 allow up to 50 distribution types, while Usage Level 3 allows up to 100 distribution types, and Usage Level 4 allows up to 150 distribution types.

- In the Manual Mode, <# Inbound Types> does not need to be entered. If it hasn't been entered, its default value will be one-half of the total number of distribution types, set only after <# of Distribution Types> is first entered. Its value cannot exceed the entered <# of Distribution Types>.

- It is possible to declare 0 distribution types on the SITESIZE command so that all subsequent calculations only apply to defined non-site VOLUMES and appropriate growth VOLFACTORS. This is particularly useful when calculating non-site volumes separately from a set of cumulated multi-site volumes, in order to separate the non-site volume definitions completely from any of the site traffic.

- The SITESIZE command can specify that all of the declared distribution types are either all inbound or all outbound. This effectively increases the number of inbound or outbound distribution types in a single calculation from a maximum of 15 to a maximum of 30 (in the largest SITE distribution Usage Level). All types

in a given calculation can be inbound, followed by a cumulated calculation of all outbound types.

SORT <Priority> <Output>

Defaults:	GOVERCS	YES
Menus/Groups:	[RESULTS]	[DESIGN]

The purpose of this command is to display the DESIGNed sequence codes and performance levels in order from best to worst performance as previously DESIGNed for the currrent intersection.

<Priority> is a keyword describing the parameter with the highest priority, and can be any of the following:

CYCLES - minimum successful cycle.
GOVERCS - minimum required G/C (default).

<Output> is a keyword describing whether or not output will be displayed, and can be any of the following:

NO - do not display output.
YES - display output (default).

Notes

- A DESIGN must be completed before a SORT command can be implemented.
- The SORT command will re-order the SEQUENCES list according to the order of the sort, thus the sequence code which is SORTed to the top of the list will be the first sequence code displayed in the SEQUENCES input dialog.
- A SORT command can be issued at any time following a DESIGN, even if intervening commands like TIMINGS, ANALYZE, HELP, DATA, etc. have been issued. Since SORT displays more DESIGN information than the DESIGN progress report itself, and is much faster than DESIGN since no new computations are performed, issuing SORT several times at various points following DESIGN is more practical than re-DESIGNing.

STARTUPLOST 12*<Startup Lost Time>

Defaults: 12*2.0
Menus/Groups: [PARAMETERS] [MOVEMENT]

The purpose of this command is to enter the length of the lost time at the beginning of a movement's green period for each of the twelve movements of the current intersection.

<Startup Lost Time> is the number of seconds which is not used at the beginning of a movement's green period, and can be any number from 0.0 to 30.0. Its default value is 2.0.

Notes

- STARTUPLOST time is used in conjunction with ENDGAIN time to calculate the lost time that an individual movement experiences during its green phase(s). The formula used from the 2000 *Highway Capacity Manual* is $t_L=l_1+l_2$, where l_1 is the startup lost time, l_2 is the ending lost time; and l_2=Y-e, where e is the endgain time.

- If the default values of STARTUPLOST and ENDGAIN (both are 2 seconds) are used for a particular movement, the lost time formula simplifies to t_L=Y. Since Y values (yellow plus all-red time) are typically in the range of 4-6 seconds, this default condition may result in lost times considerably higher than the default lost time value of 3.0 seconds which was used in the 1985 and 1994 *Highway Capacity Manuals*. When this is the case, users should expect less effective green time for these movements versus those used in comparable 1985 and 1994 analyses, which will result in higher v/c and delay values, and thus likely worse levels of service.

STOP <Next Program>

Defaults: --
Menus/Groups: [CONTROL]

The purpose of this command is to stop running the current program and optionally run a new program.

<Next Program> is the name of another program which is to be run following the end of the current program, and can be any valid program name. Its default value is blanks; no program will be run following the end of the current program.

Notes

- <Next Program> may also include a file name to be used by the named program.

- The command QUIT may be used in the Manual Mode as an alias command to represent the STOP command. It cannot be used in any <List of Commands> entries such as with ASK or HELP.

STORAGE 12*<Storage Distance>

Defaults: 12*0
Menus/Groups: [PARAMETERS] [MOVEMENT]

The purpose of this command is to enter the amount of storage distance for queued vehicles for each of the twelve movements of the current intersection.

<Storage Distance> is the distance, in feet, which can be used to store a queue of vehicles without obstructing vehicles in other lane groups or at other intersections, and can be any integer from 0 to 9999. Its default value is 0.

Notes

- The storage distance is used to calculate the queue ratios in the 2000 *Highway Capacity Manual* back of queue analysis, as well as in the QUEUECALCS calculation of various queue model results. If no storage distances are entered, the queue calculations will report the queues only in terms of vehicles per lane and feet per lane, without storage ratios.

SUBSYSTEM 500*<Node Number>

Defaults: 500*0
Menus/Groups: [PARAMETERS] [SYSTEM]

The purpose of this command is to enter the subset of the NODELIST for which subsequent actions should be taken.

<Node Number> is a unique number assigned to each intersection on INTERSECTION command, and can be any integer from 0 to 999 or the negative value of any defined route number. Its default value is 0.

Notes

- This is one of several entries (including NODELIST, SUBSYSTEM, INTERSECTION, NODELOCATION and NETWORK) which can be made or might be altered when using the drag-and-drop network creation/editing functions in the main window. Entries made from a dialog will change the values created in the main window, and vice-versa.

- The SUBSYSTEM command allows a subset of the complete NODELIST to be defined for subsequent analysis in Usage Level 3+ versions of SIGNAL2000. This means that the entire network (up to 500 signals) may be LOADed into SIGNAL2000, then only the pertinent signals are ANALYZEd or DESIGNed.

- Like NODELIST, the entry of a 0 node in the SUBSYSTEM list will terminate the SUBSYSTEM list of nodes and zero out any subsequent nodes in the list.

- In Usage Level 3, SUBSYSTEM can be as many as 100 nodes in length. In Usage Level 4, SUBSYSTEM can be as many as 500 nodes in length.

- When in the Visual Mode or using the ASK command to enter the SUBSYSTEM, the actual list can be enetered only once. After this entry, the list must be modified one intersection at a time with the edit buttons of the SUBSYSTEM dialog. When entering the SUBSYSTEM this first time, type no more than 80 characters per entry, using ampersands (&) to continue long entries to subsequent entry lines.

- The order of entries on SUBSYSTEM has no effect on the order that the intersections are analyzed. The NODELIST defines this order.

- Route numbers can be referenced by use of a negative number on the SUBSYSTEM command to quickly identify a route for analysis. For example, if ROUTE 1 is defined by an appropriate ROUTE command, a subsystem analysis

for only this route can be created through the use of the SUBSYSTEM -1 command.

SUMMARISE --

Defaults: --
Menus/Groups: [DATAFILES]

The purpose of this command is to display a formatted summary of all [PARAMETERS] values. It has no parameters.

Notes

- SUMMARISE is similar in function to DATA, but provides better column organization and section headings, where DATA only lists the current data values for each command. DATA, on the other hand, allows selection of which command's data to view, and can sometimes save time, whereas SUMMARISE will always display all data values.

- The SUMMARISE command is spelled with an 'S' at the end in order that it does not conflict with the typical command SIZE. If SUMMARISE were spelled with a 'Z', then typing the full command SIZE would still be an ambiguous abbreviation for both the SIZE and SUMMARIZE commands, and the SIZE command could never be executed.

TIMINGS <Sequence Code> <Output>

Defaults:	-1	TIMINGS
Menus/Groups:	[RESULTS] [DESIGN]	

The purpose of this command is to retrieve the optimum timings for the sequence code specified from previously DESIGNed results for the current intersection.

<Sequence Code> is a two-digit sequence code, and can be either a sequence code or position code, as follows:

Sequence Code: 11, 12, 13 thru 88.
Position Code: -1, -2, -3, etc
(default -1, the first entry of the SEQUENCES list)

<Output> is a keyword describing what type of output display is desired, and can be any of the following:

NONE	- no output is displayed.
TIMINGS	- only timings output displayed (default).
DIAGRAM	- display timings & phasing.

Notes

- The TIMINGS command is the link between the DESIGN and ANALYZE commands. Not only does it display the optimum timings which have been generated by DESIGN, but it also moves the selected phasing to the top of the SEQUENCES list and inputs these timings, in seconds, into the GREENTIMES, YELLOWTIMES, and CRITICAL commands. This means that TIMINGS xx followed by ANALYZE is a simple way to generate a capacity analysis of optimum timings for sequence xx.

- If a negative sequence code is given, the absolute value of the number is taken to represent the position of the desired sequence code in the SEQUENCES list. Thus, a -3 entry will produce optimum timings for the third sequence code in the SEQUENCES list.

TRUCKCOUNTS	<Movement or Time>	<List of Counts>
Defaults:	none	(zeros)
Menus/Groups:	[PARAMETERS] [TURNS/WARRANTS]	

The purpose of this command is to enter the count of trucks for a count interval or movement number at the current intersection.

<Movement or Time> is the movement number or the beginning time of the time interval for the counts to be entered, and can be any of the following:

1-12 (Movement number), or
0-2400 (Beginning time)

This parameter has no default value, and must be entered each time the TRUCKCOUNTS command is used.

<List of Counts> is the list of counted trucks for the specified movement number or time interval, and can be any number from -999 to 9999. Its default value is 0, e.g., it must be entered.

Notes

- Movement numbers begin with the north leg right-turn and proceed clockwise around the intersection. If a movement number is given for the first parameter, the counts should be for that movement only, one for each interval in each of the periods. If a time is given, twelve counts for each of the movements at that time should follow. Use of the movement number option is limited to the Manual Mode only.

- Usually, for capacity analysis purposes, vehicles with 6 or more tires or 3 or more axles should be considered trucks (heavy vehicles).

- All counted trucks entered by this command may either be included or not included in the counts on the VEHICLECOUNTS command. This is determined by the second parameter of the COUNTTYPE command.

- Truck counts may not exceed 9999. Input should always be no more than four digits. If cumulative counts are made with five-digit counters, only enter the last four digits. When cumulative counts are being reduced, if the difference is negative (the counter turned over the 9999 mark to 0000), TURNS automatically adds 10,000 to the negative result.

TRUCKPERCENTS 12*<Truck-Through Bus Percentage>

Defaults: 12*2
Menus/Groups: [PARAMETERS] [BASIC] [MOVEMENT]

The purpose of this command is to enter the truck and through bus (heavy vehicle) traffic percentage for each movement of the current intersection.

<Truck-Through Bus Percentage> is the percentage of trucks and through buses in each movement volume, and can be any number from 0 to 99.9. Its default value is 2.0.

Notes

- TRUCKPERCENTS includes any designated "heavy vehicles", as defined by the 2000 *Highway Capacity Manual*.

UPSTREAMVC 4*<Upstream v/c Ratio>

Defaults: 4*0.0
Menus/Groups: [PARAMETERS] [APPROACH]

The purpose of this command is to enter the v/c ratio of the upstream intersection for each approach of the current intersection.

<Upstream v/c Ratio> is the v/c ratio of the upstream intersection, and can be any number from 0.0 to 3.0. Its default value is 0.

Notes

- Note that although many intersections in a network may be entered into SIGNAL2000, the upstream v/c is a user entry and is not determined by the program based conditions in other parts of the network.

UTILIZATIONS 12*<Lane Utilization Factor>

Defaults: 12*0.00
Menus/Groups: [PARAMETERS] [MOVEMENT] [94DEFAULTS]

The purpose of this command is to enter the lane utilization factor for each movement of the current intersection.

<Lane Utilization Factor> allows the specification of non-uniform lane usage, and can be any number from 0.00 to 1.00. Its default value is 0.00 (see below).

Notes

- If an input value of 0.00 is made (the default), this indicates a desire by the user for the 2000 *Highway Capacity Manual* default values to be used.

- Specifying a value of 1.00 indicates the desire to evaluate the overall performance of the lane group, not the heaviest-traveled lane of the lane group.

- Lane utilizations are used to determine the adjusted saturation flow rate for use in the v/c and delay calculations, as well as queues. As such, caution should be used in applying lane utilization factors substantially less than 1.00 since in these cases the analysis is only valid for the heaviest-traveled lane (not the entire lane group), and this aspect of the analysis may be overlooked by those looking at the analysis summary.

VEHICLECOUNTS	**<Movement or Time>**	**<List of Counts>**
Defaults:	none	(zeros)
Menus/Groups:	[PARAMETERS] [TURNS/WARRANTS]	

The purpose of this command is to enter the count of vehicles for a count interval or movement number at the current intersection.

<Movement or Time> is the movement number or the beginning time of the time interval for the counts to be entered, and can be any of the following:

1-12 (Movement number), or
0-2400 (Beginning time)

This parameter has no default value, and must be entered each time the VEHICLECOUNTS command is used.

<List of Counts> is the list of counted vehicles for the specified movement number or time interval, and can be any number from -999 to 9999. Its default value is 0, e.g., it must be entered.

Notes

- Movement numbers begin with the north leg right-turn and proceed clockwise around the intersection. If a movement number is given as the first parameter, the counts should be for that movement only, one for each interval in each of the periods. If a time is given, twelve counts for each of the movements at that time should follow. Use of the movement number option is limited to the Manual Mode only.

- If the truck COUNTTYPE is INCLUDED, all counted vehicles should be included in these entries, including any trucks specified by the TRUCKCOUNTS command. If the truck COUNTTYPE is SEPARATE, VEHICLECOUNTS should be all vehicles except trucks, which will be entered only on the TRUCKCOUNTS command.

- Vehicle counts may not exceed 9999. Input should always be no more than four digits. If cumulative counts are made with five-digit counters, only enter the last four digits. When cumulative counts are being reduced, if the difference is negative (the counter turned over the 9999 mark to 0000), TURNS automatically adds 10,000 to the negative result.

VOLADDITIONALS <AddFactor> 12*<Additional Volume>

Defaults: 1 12*1.00
Menus/Groups: [PARAMETERS] [MOVEMENT]

The purpose of this command is to enter the factor and additional volume to be added for each movement at the current intersection.

<AddFactor> is the factor which is multiplied by each <Additional Volume> entered to get the total additional volume added to each movement, and can be any number from 0.0 to 20.0. Its default value is 0.00 (no additional volumes added).

<Additional Volume> is a volume of additional traffic to be added to the entered volumes, as adjusted by the <AddFactor>, and can be any number from -9999 to 9999. Its default value is 0.

Notes

- Normally <AddFactor> will have a value of 0.0 or 1.0 to disable or enable, respectively, any <Additional Volumes> which have been entered, without the need to actually change the <Additional Volume> entries. This feature makes it easy to add and remove additional volumes from an analysis. <AddFactor> may also be used as a multiplier for the <Additional Volumes> for easy testing of incremental values of additional volumes.

- See the discussion in Appendix C (Calculation of Volumes) for a complete discussion of how VOLUMES, VOLFACTORS, VOLADDITIONALS and PEAKHOURFACTORS are used to generate analysis volumes for various types of analyses within TEAPAC.

VOLFACTORS <# Years> 12*<Adjustment Factor>

Defaults:	1	12*1.00
Menus/Groups:	[PARAMETERS] [MOVEMENT]	

The purpose of this command is to enter number of times to compound and each multiplier used for each movement to adjust the volume or count data entered at the current intersection.

<# Years> is the number of times (years) to compound each multiplier, and can be any positive integer from 1 to 99. Its default value is 1 (no compounding).

<Adjustment Factor> is a multiplier used to adjust the movement volumes or counts input to the program, and can be any number from 0.0 to 9.99. Its default value is 1.00 (no adjustment).

Notes

- If a number greater than one is entered for the <# Years>, the <Adjustment Factor> will be taken as an annual growth factor for entered traffic volumes or counts, applied for each of the years entered. For example, if the growth rate is 2 percent per year over 3 years, a VOLFACTORS 3 1.02 entry would be made to effect a 1.0612 adjustment to entered volumes or counts (=1.02 x 1.02 x 1.02).

- The use of VOLFACTORS will adjust all volumes displayed in the output reports by the specified factors. It will not change the volume or count values entered. This is a convenient way to adjust traffic count data for seasonal variations in count data or to apply a projected growth factor

- VOLFACTORS can also be used to project growth of traffic at the intersection, for example, if the count is several years old and must be used for a current study or to project a future volume condition.

- See the discussion in Appendix C (Calculation of Volumes) for a complete discussion of how VOLUMES, VOLFACTORS, VOLADDITIONALS and PEAKHOURFACTORS are used to generate analysis volumes for various types of analyses within TEAPAC.

VOLUMES 12*<Design Hour Volume>

Defaults: 12*0
Menus/Groups: [PARAMETERS] [BASIC] [MOVEMENT]

The purpose of this command is to enter the turning and through movement volumes for each of the movements of the current intersection.

<Design Hour Volume> is the demand volume for the analysis period, in vehicles per hour, for the movement, and can be any integer from 0 to 9999. Its default value is 0.

Notes

- A volume of 0 indicates the movement is prohibited at the intersection - allowed movements with no measured activity should show at least 1 vehicle per hour.

- Entered demand VOLUMES will be adjusted by the entered PEAKHOURFACTORS as a means of estimating the peak flow rate during the analysis period. When the analysis period is the default of 15 minutes (0.25 hours), this means that an entered volume divided by the peak hour factor will estimate the flow rate during the peak 15 minute analysis period for each movement. If 15-minute data is available directly (e.g., from count data), using this 15-minute data (the 15-minute count times 4) with peak hour factors of 1.00 is preferred over making the approximation using a peak hour factor. In particular, if different peak hour factor data is entered for each individual movement, the estimate will likely produce a ficticious set of analysis flow rates which may represent flow conditions which never occur since all the movements may not peak at the same time.

- See the discussion in Appendix C (Calculation of Volumes) for a complete discussion of how VOLUMES, VOLFACTORS, VOLADDITIONALS and PEAKHOURFACTORS are used to generate analysis volumes for various types of analyses within TEAPAC.

WIDTHS 12*<Lane Group Width>

Defaults: 12*0
Menus/Groups: [PARAMETERS] [BASIC] [MOVEMENT]

The purpose of this command is to enter the width of the lane group for each movement of the current intersection.

<Lane Group Width> is the width, in feet, of the lane group for each movement, and can be in the range of 0.0 - 60.0 feet. Its default value is 0.0 feet.

Notes

- The <Lane Group Width> entry for a lane group should include the width of pavement that is used by moving traffic, and should not include the width of any pavement which is used exclusively by parked vehicles.

- Widths for turning movements should be entered only if the approach has exclusive turning lanes. If no exclusive turning lanes exist, the turns will be made from the adjacent through lane group.

- Turning movements which turn from both exclusive turn lanes and shared through lanes should make use of the GROUPTYPES entry to define this condition which SIGNAL2000 calls dual optional lane usage.

- Values for LANES are automatically generated each time a new lane width is given on a WIDTHS command. The number of lanes generated is defined by the tens digit of the approach width (in feet). Approach widths of less than ten feet and greater than zero are assumed to have one lane. Thus, usage of the LANES command is necessary only for those lanes where this assumption of number of lanes is not appropriate.

- An error is generated during analysis functions like ANALYZE and DESIGN if the calculated average lane width is less than 8.0 feet. No extrapolation is allowed below this limiting value.

YELLOWTIMES 6*<Phase Yellow Time>

Defaults: 6*0.0
Menus/Groups: [PARAMETERS] [BASIC] [PHASING] [ANALYZE]

The purpose of this command is to enter the clearance interval at the end of each phase of a phase sequence, or optionally for each of the movements, of the current intersection.

<Phase Yellow Time> is the duration of the clearance interval after each phase or movement in seconds or seconds/second, and can be any number from 0 to 900. Its default value is 0.0 seconds.

- If the list of YELLOWTIMES is preceded by the keyword 'Movmt', then each of the entered values will be interpreted as timings for individual through and left turn movements, clockwise around the intersection. If not, or the optional keyword 'Phase' is used, each value is for the phases defined by the SEQUENCE code.

- When entering or viewing controller timings, a Convert button appears on the YELLOWTIMES dialog which allows the user to select the style of entry or view, either 'By Phase' which is the traditional HCM method, or 'By Movement' which is more similar to the way timings are used on NEMA and other dual-ring controllers. If any timings are present, they will be converted to the other format at the same time, including YELLOWTIMES if the GREENTIMES dialog is displayed, and vice versa. When timings are Converted, the conversion will also include reviewing the allowed SEQUENCES list and moving the appropriate sequence code to the top of the list according to the timings present.

- It is important to make sure that YELLOWTIMES and REQCLEARANCES entries are always kept consistent with each other, especially when converting Timings by Phase to Timings by Movement and when exporting to third-party, ring-based software.

- 'By Movement' timings are not allowed when special phasings represented by negative SEQUENCE codes are used.

- If entering YELLOWTIMES by phase, they must be entered in the order of the phases as specified in the SEQUENCES and LEADLAGS commands.

- All-red time should be included in the YELLOWTIMES command.

- If all YELLOWTIMES are entered in seconds/second, the first cycle length of the CYCLES command will be used to convert the phase clearance times to seconds. Normally, YELLOWTIMES should be entered in seconds.

- If all entries are greater than or equal to 1.0, they are assumed to be seconds; if all entries are less than 1.0, they are assumed to be seconds/second.

- In order to calculate lost times for each movement, YELLOWTIMES must be available for each phase or movement. If they are not entered, a default lost time of 4 seconds will be used.

- If a signal is to be double-cycled, GREENTIMES, YELLOWTIMES (and OFFSETS) must be entered in seconds (not sec/sec) which sum to 1/2 the system cycle.

A P P E N D I X   C

Analysis Methods and Formulations

Appendix C Topics

SIGNAL2000 adheres strictly to the methods, formulations and computational procedures of the 2000 *Highway Capacity Manual* (HCM). This includes the calculation of saturation flow, capacity, v/c, queues, delay and level of service, with all of their associated factors.

The following sections describe additional calculations above and beyond those described in the 2000 *Highway Capacity Manual* which are implemented in SIGNAL2000, as well as computational procedures which the user might perform in using SIGNAL2000 to its fullest potential.

Appendix C Topics:

Calculation of Volumes

In the simplest form, a user enters volumes (V) for each intersection movement with the VOLUMES dialog and these volumes are used in any subsequent analyses which requires a measure of traffic demand. These volumes are provided in vehicles per hour and frequently they represent the average hourly flow rate (or equivalently, the hourly count) for the hour to be analyzed. Since the *Highway Capacity Manual* (HCM) dictates that the normal analysis period is to be 15 minutes, the PEAKHOURFACTORS entry (PHF) is then used to estimate the flow rate (v) during the peak 15 minutes of the hour for which the average hourly volume is entered.

$$v = V / PHF$$

where: v = analysis flow rate during peak 15 minutes of the hour (vehicles per hour)
V = entered average hourly VOLUME during the hour (vehicles per hour)
PHF = 15-minute peak hour factor (ratio of average flow to peak 15-minute flow)

If the actual peak 15-minute flow rate (vph) is known and entered as the VOLUMES entry (e.g., a 15-minute count multiplied by four), then the PEAKHOURFACTORS entry should be set to 1.0 so that $v = V$ above and the entered VOLUME will become the analysis flow rate.

In order to facilitate sensitivity and alternative analyses, the VOLUMES entry can be modified by two other related entries. First, the VOLFACTORS entry can be used to multiply each VOLUMES entry by a factor. This is simply a multiplicative factor, either to inflate or deflate the entered volume. It is entered in such a way that it can also be interpreted as a growth factor if such an interpretation is appropriate. First, a number of years (N) is entered which applies to all VOLFACTORS for the intersection, then individual factors (f_V) are given for each movement. The entry for number of years (N) is actually the number of times the individual factors (f_V) will be compounded, in which case the entered factor (f_V) can be more generally interpreted as a periodic growth factor and the number of years (N) can be interpreted as the number of periods which the growth factor (f_V) is compounded.

$V' = V * (f_V ** N)$

where: V' = factored average hourly volume for analysis (vehicles per hour)
V = entered average hourly VOLUME during the hour (vehicles per hour)
f_V = entered VOLFACTOR adjustment factor (for each N periods)
N = entered VOLFACTOR number of periods to compound the f_V factor

If a simple inflation or deflation factor is all that is required, the number of years should be entered as $N = 1$, in which case $V' = V * f_V$ above.

A second volume adjustment entry can be made via the VOLADDITIONALS dialog. This is an additive value above and beyond the adjustment described above for VOLFACTORS. First, a factor (f_{add}) is entered which applies to all additional volumes for the intersection, then individual additional volumes (V_{add}) are given for each movement. In its simplest form, the factor entered is either 0 (zero) or 1 (one) to either exclude or include the additional volumes given, repectively. This makes it easy to leave the additional volume entries but remove and/or re-include them in the analysis with a single factor entry. In its broadest application, the entered factor (f_{add}) can be used to inflate or deflate the additional volume entries (V_{add}) by the factor entered.

$V' = V + V_{add} * f_{add}$

where: V' = adjusted average hourly volume for analysis (vehicles per hour)
V = entered average hourly VOLUME during the hour (vehicles per hour)
V_{add} = entered VOLADDITIONAL additional volume
f_{add} = entered VOLADDITIONAL adjustment factor

Thus, in the most general form, the demand volumes used for an analysis are determined using the following formula:

$$v = (V * (f_V ** N) + V_{add} * f_{add}) / PHF$$

where:
- v = analysis flow rate during peak 15 minutes of the hour (vehicles per hour)
- V = entered average hourly VOLUME during the hour (vehicles per hour)
- f_V = entered VOLFACTOR adjustment factor (for each N periods)
- N = entered VOLFACTOR number of periods to compound the f_V factor
- V_{add} = entered VOLADDITIONAL additional volume
- f_{add} = entered VOLADDITIONAL adjustment factor
- PHF = 15-minute peak hour factor (ratio of average flow to peak 15-minute flow)

The TURNS and WARRANTS programs of TEAPAC can determine peak-hour or peak-15-minute volumes from entered traffic count data using the ANALYZE function. In these programs, entered VOLUMES and VOLADDITIONALS are ignored by ANALYZE and the results of the peak analysis are placed in the VOLUMES entries automatically. VOLFACTORS are applied to the traffic count data as 'growth' or 'seasonal' adjustment factors, thus the resulting automatic VOLUMES entries have these same VOLFACTORS removed so that the calculation of analysis volumes from the general formula above will result in the same peak volumes determined by the ANALYZE function. For example, if count data is analyzed with a VOLFACTORS growth factor of 10% ($f_V = 1.10$ and $N = 1$) and results in a peak volume of 110 vph, the corresponding VOLUMES entry will be set to 100 vph so that the VOLFACTORS entry will inflate the VOLUME to 110 for analysis. PEAKHOURFACTORS are also set according to the specification of the TURNS or WARRANTS OUTPUT dialog, as are TRUCKPERCENTS. VOLADDITIONALS entries are unaffected by the ANALYZE results.

The SITE program of TEAPAC can estimate future volumes due to the impact of certain specified development scenarios. In this program, the VOLUMES entries are used as the background traffic for the complete scenario assessment by the COMPUTE function, including the effect VOLFACTORS has on these background VOLUMES. VOLADDITIONALS, however, have no effect on the computations, and the results of the scenario computations are placed in the VOLADDITIONALS entries automatically (with the contribution of VOLUMES and VOLFACTORS removed) so that the calculation of analysis volumes from the general formula above will result in the same volume scenario determined by the COMPUTE function. For example, if a counted movement VOLUME is 100 and the background traffic growth VOLFACTOR entry is 1.10 ($f_V = 1.10$ and $N = 1$), resulting in 110 vph projecterd background traffic, and the computed total traffic for that movement under a given development scenario is 250 vph, the VOLADDITIONAL entry will be 140 vph (with $f_{add} = 1.0$) so that the computed analysis volume for subsequent analyses will result in 250 vph.

In summary, analysis volumes are computed for performance assessments and design functions as the combination of entered volumes (VOLUMES), 'growth' factors (VOLFACTORS) and additive volumes (VOLADDITIONALS), and adjusted by peak hour factors (PEAKHOURFACTORS). VOLUMES and PEAKHOURFACTORS (and

TRUCKPERCENTS) can be determined directly by TURNS and WARRANTS from traffic count data, including the effect of 'growth' or 'seasonal' factors (VOLFACTORS) and ignoring any entered VOLUMES, PEAKHOURFACTORS or VOLADDITIONALS (or TRUCKPERCENTS). VOLADDITIONALS can be determined directly by SITE for development scenarios, including the effect of 'growth' factors (VOLFACTORS) on any entered VOLUMES and ignoring any entered VOLADDITIONALS. This process makes for a completely seamless integration of all of the TEAPAC programs with respect to consistent traffic volumes used by each program.

Optimization Scheme

The default optimization strategy of SIGNAL2000 is to produce an optimized capacity analysis by setting the phase timings such that each of the ‘critical’ movements of each phase have approximately the same delay values (and thus the same level of service), whenever possible. By accomplishing this, no time can be taken from one phase and given to another without disrupting this balance of delay. One condition which may prevent this objective from being fully achieved is when such optimal green times do not provide enough time to meet designated minimum green times. Another is when the critical movements are over-saturated.

An important observation is that this strategy is not intended to minimize the overall delay of the intersection, and in many cases will not. The reasoning for this is straightforward: In a simple case where a major street intersects a minor street with a two-phase signal, the imbalance in street volumes will inherently favor the main street with regard to the overall intersection delay, and to an extreme which is not appropriate and clearly not "optimal." For example, if the main street has volume of 1,000 vph on it and the side street has 100 vph, an optimization of intersection delay will force the delay value of the side street ten times higher than the main street since the main street volume is ten times higher than the side street and the intersection delay is the weighted-average delay (weighted by volume). Thus, if the main street experienced 20-35 seconds of delay (LOS C), then the optimum side street timing would cause 200-350 seconds of delay for side-street vehicles! Clearly this is not appropriate or optimal. This argument holds true for other "minor" movements at the intersection, such as left turn phases for either the main street or side street. As such, SIGNAL2000 provides a unique optimization strategy that balances the delay of the critical movements, so that this inappropriate allocation of greentime does not occur. This is the default optimization strategy, but others can be selected, as described in a following section.

Defining Priority Movements for an Optimization

The optimization strategy described above is the default scheme which treats all critical movements with equal priority. As a default, this must be the case, since it is beyond the scope of the program to identify priority movements on its own. On the other hand, quite often it is both desirable and appropriate to specify certain movements within an intersection which are to

receive some degree of priority treatment, while maintaining a certain minimum level of performance on all other critical movements which are not priority movements. This process is described below.

The EXCESS command can be used to define movements which are to receive priority treatment during the optimization process. These priority movements are defined simply by listing their movement numbers on the EXCESS command. For example, if the northbound through movement is the most important movement during the P.M. peak, movement 8 can be entered as the EXCESS movement. In this case, if the target delay as defined by the first LEVELOFSERVICE command entry is met for all critical movements, all remaining time will be allocated to the phase which serves movement 8 (the northbound through movement).

If the default LEVELOFSERVICE entry of 35 seconds of delay (LOS C) is used, this means that if all of the critical movements can be operated at LOS C, then the optimum timings will be set such that each critical movement except movement 8 will experience 35 seconds of delay and all remaining time will be allocated to the phase that serves movement 8. This will be reflected in a subsequent capacity analysis showing the intended imbalance in delays among the critical movements, all being nominally 35 seconds except the priority movement 8 having less delay.

The significance here is that the delay of the non-priority critical movements can be specifically targeted, with all extra time beyond that target going to the priority movements. Note that if the target delay is not met, then the EXCESS movement(s) are ignored and all critical movements are allocated time intended to balance the delays of the critical movements at a value worse than the target level of service.

The effect of defining priority movements can be exaggerated by raising the target delay on the LEVELOFSERVICE command. For example, even if LOS C can be achieved for the critical movements but the north and south through movements must be further prioritized, a higher target can be selected with a LEVEL D entry and the movements can be prioritized with a EXCESS 2 8 entry, all followed by DESIGN/SORT/TIMINGS/ANALYZE (or just DESIGN 1). In this case, the phase(s) serving movements 2 and 8 will receive all of the excess time above LOS D performance and the non-priority critical movements will receive nominally 55 seconds of delay (LOS D). This strategy might be used, for example, in a case where additional time is desired for the main street for progression purposes, but a specific limiting delay or level of service is to be established for the minor critical movements (a unique feature of SIGNAL2000 in comparison to PASSER and TRANSYT). This strategy might also be a standard option for signals being timed along a state highway route.

Oversaturation Considerations

When conditions are oversaturated at an intersection, the basic objective of balancing delay for the critical movements is frequently not appropriate or even desireable. When this is the case, or any time the maximum delay/LOS of the LEVELOFSERVICE entry is exceeded, SIGNAL2000 reverts to a different optimization policy. The new policy is to balance the v/c values of the critical movements rather than the delay values. The oversaturated design policy is invoked any

time the critical movement delay of the DESIGN becomes worse than the maximum delay allowed. This is represented by LOS V or S in the DESIGN and SORT tables. LOS V is when a v/c target is achieved. LOS S is primarily intended to indicate "S"aturation as the design policy when the maximum v/c is exceeded.

It must be recognized, however, that this policy may not produce sensible results, depending on the nature of the oversaturation. For example, if a single left turn at the intersection is substantially oversaturated, say with 350 vehicles in a single left turn lane, but all other movement volumes are well within reasonable limits for their geometrics, all of the other movements will be made to suffer with limited greentime allocation in SIGNAL2000's attempt to allocate enough greentime to the single offending left turn and to balance either the delay or the v/c. In this case, it may make more logical sense to let the single left turn fail miserably while the remainder of the intersection performs reasonably. This is a strategy which can only be handled by manual optimization by the user. The bottom line here is that no single optimization strategy will make sense for all over-saturated conditions, and the user should review the results of over-saturated optimization carefully to make sure the results are sensible and that all constraints such as minimum green times have been met.

Note also that the user can invoke the v/c balancing optimization policy at any time simply by selecting 0 as the target delay on the LEVELOFSERVICE command.

Calculation of Queues

SIGNAL2000 calculates queue lengths according to the methods dictated by the 2000 *Highway Capacity Manual* (HCM), as well as several other queueing models, as described in this section. Any one of the models described can be selected through use of the QUEUEMODELS command so that its results are displayed in the results produced by the ANALYZE and EVALUATE commands. The results of all of the queue models can be produced side-by-side by using the QUEUECALCS command in a manner that allows quick comparison of all of the models.

The purpose of this QUEUECALCS report is to first illustrate that the queue models which have been used over the years deliver widely varying results, and thus cannot all be valid under all conditions. This is intended to lead the user to the conclusion that a robust queue model is needed that can be relied upon under a wide range of conditions, with the clear suggestion that the 2000 HCM model is that robust model. In this regard, the HCM queue model takes into account the effects that all of the following conditions have on queueing: volume of demand, actual green time, cycle length, saturation flow, capacity, v/c, maximum extent of queue on pavement, coordinated operation, actuated operation, unbalanced lane utilization, protected-permitted operation, over-saturation, upstream v/c, initial queues, length of analysis period, average storage length of queued vehicles and various percentile estimates.

Secondly, the QUEUECALCS result allows quick comparison of the 2000 HCM model results to more familiar, historical models so users can become comfortable with the HCM model in that light. It is anticipated that over time the HCM model will become the model of choice, and as such, the HCM Model #1 is the default model of SIGNAL2000.

SIGNAL2000 calculates queues using four basic model structures: the 2000 HCM model, the ARRB model, the MBQ model, and the SIGNAL97 model. Several variations of these models are computed, as described below, bringing the number of models calculated to eight. The basis of the variatiions revolve around whether the average or percentile queue value is calculated, and whether constant or user-input vehicle spacings are used. The following tabulates the characteristics of each of the eight models used, followed by a detailed description of each model.

1 - HCM	2000 HCM, MBQ, Worst Lane. XXth Percentile Queue
3 - ARRB	ARRB, MBQ, Worst Lane, 95th Percentile Queue
4 - HCM	2000 HCM, MBQ, Worst Lane, Average Queue
6 - MBQ	Historical MBQ, Average Lane, Average Queue
7 - S97E+	SIGNAL97 Evaluate+, MQL, Average Lane, XXth Percentile Queue
8 - S97A+	SIGNAL97 Analyze+, MQL, Average Lane, XXth Percentile Queue
9 - S97E	SIGNAL97 Evaluate, MQL, Average Lane, 90th Percentile Queue
10 - S97A	SIGNAL97 Analyze, MQL, Average Lane, 90th Percentile Queue

In the following discussions, the term “maximum back of queue” (MBQ) queue model is used to indicate the maximum extent of queued vehicles back from the stop bar, and the term “maximum queue length” (MQL) is used to indicate the maximum number of vehicles in queue. It must be understood that the MBQ value refers to a point on the pavement where the last queued vehicle is located, and when it is described in vehicles per lane it is meant to describe that position on the pavement ‘as if’ that number of vehicles were actually standing in line from the stop bar back to that point, when in reality it is the only queued vehicle, since all other previously queued vehicles have already re-started. The MBQ inherently occurs at a point in time somewhat after the end of red, since time must pass in order for all prior queued vehicles to depart. In contrast, the MQL inherently occurs exactly at the end of the red period, since this is when the greatest number of queued vehicles will exist. It can also be said that for a given percentile, the MBQ value will always exceed the MQL value.

A variable of general concern in all of the queue models is whether the queue value is determined for the worst lane or the average lane of a multi-lane lane group. The worst lane is the lane of the lane group with the highest volume, as defined by the lane utliization factor. Each model is specifically for one or the other of these conditions.

Another variable of general concern is whether the queue model calculates an average queue value, or a percentile queue value. The average queue means that if the queue of concern was observed in the field N times, the calculated value would be an estimate of the average of those N observations (the sum of all observations divided by N). A percentile queue value means that for all observations, the given percentage of the observations would be equal to or less than the calculated value. For example, in 50 observations, the 90th percentile is the 45th highest observed queue. Some models which predict percentile queues have a fixed percentile value, while others have a limited range of allowed percentiles, and the SIGNAL97 enhanced model allows any percentile.

In some cases the queue value or distance occupied cannot be computed or cannot be displayed for one of several possible reasons. In these cases, asterisks '*****' are displayed. For example, for grossly oversaturated conditions, the calculated length of a given queue (in feet) may exceed the integer arithmetic used which has a maximum of 32,767 feet (over six miles!). Also, in Models 7 & 8 where the poisson distribution is used, the factorial portion of the formula may exceed the computational limits of the computer when queues approach one mile in length.

2000 HCM Queue Model
ARRB Queue Model
MBQ Queue Model
SIGNAL97 Queue Model

2000 HCM Queue Model

Models 1 and 4 use the maximum back of queue (MBQ) model defined by the 2000 *Highway Capacity Manual*, each using different assumed conditions, as follows. Model 1 is the percentile queue for the worst lane in a lane group, and Model 4 is the average queue for the worst lane in a lane group. In both cases, the worst lane is defined by the lane utilization factor used. The complete documentation for this model can be found in Appendix G of the 2000 *Highway Capacity Manual* and the calculations can be observed in the HCM Back of Queue Worksheet which is produced when the worksheet output is selected. The percentile values used are the percentile values allowed by the HCM which are closest to those which are requested by the user. The allowed percentiles are 70%, 85%, 90%, 95% and 98%, meaning that when a given percentile is calculated, it is expected that that percentage of all of the observed queues will be the calculated value or less. The distance back from the stop bar is determined using the queued vehicle length inputs made by the user.

Note that the first publication of the 2000 HCM allowed the computation of an average lane queue even if an unequal lane utilization factor was used to calculate saturation flow rates. A published amendment to the 2000 HCM now restricts the computation of a queue to match the lane utlization factor used for saturation flow rates. Previous versions of SIGNAL2000 calculated these queues as Models 2 and 5, which have since been eliminated.

ARRB Queue Model

Model 3 uses the maximum back of queue (MBQ) model defined by the Australian Road Research Board, as implemented in the SIDRA5 model. The complete documentation for this model can be found in the SIDRA5 manual. It is the 95th percentile queue for the worst lane in a lane group, meaning that it is expected that 95% of all of the observed queues will be the calculated value or less. The distance back from the stop bar is determined using the queued vehicle length inputs made by the user.

MBQ Queue Model

Model 6 uses the maximum back of queue (MBQ) model from standard queueing theory. It is the average queue for the average lane in a lane group, meaning that it is expected that about half of all of the observed queues will be the calculated value or less. The distance back from the stop bar is determined using the queued vehicle length inputs made by the user.

Q_n = q * r / (1-v/s) / N

where:
- Q_n = number of vehicles in queue per lane
- q = arrival rate (vehicles per second)
  = v/3600
- v = adjusted volume (vehicles per hour)
- s = adjusted saturation flow rate (vehicles per hour of green)
- r = time that is not effectively green (seconds), e.g., "effective red time"
  = C * (1-g/C)
- C = cycle length (seconds)
- g = effective green time (seconds)
- N = number of lanes in lane group

Q_l = L_c * T_f * Q_n

where:
- Q_l = length of queue per lane(feet)
- L_c = average queued spacing between car front bumpers (feet)
- Q_n = number of vehicles in queue per lane (from above)
- T_f = truck length factor
  = 1 + (L_t/L_c -1)* HV/100
- L_t = average spacing between truck front bumpers (feet)
- HV = percent trucks/heavy vehicles (%)

SIGNAL97 Queue Model

Models 7, 8, 9 and 10 use the maximum queue length (MQL) model as defined in the SIGNAL97/TEAPAC program. These models have also appeared in the earlier versions of SIGNAL97: SIGNAL94, SIGNAL85 and SIGNAL. The computations are made according to standard queuing theory, commonly referred to as the "red time formula", since the basis of the model is the calculation of the number of arrivals during the red time of each cycle, q*r. It is the percentile queue for the average lane in a lane group, meaning that it is expected that that percentage of all of the observed queues will be the calculated value or less.

Models 9 and 10 use an adjustment factor of 2.0 as a means of estimating the 90th percentile queue, and the queued distance for automobiles and trucks is assumed to be 25 and 40 feet, respectively. These are the strict models found in SIGNAL97 (S97E and S97A). Models 7 and 8 use the same models as 9 and 10, respectively, but calculate the percentile queue for the percentile input by the user based on actual cumulative Poisson arrival probabilities (not a 2.0

factor), and the queue distances are estimated using the queued vehicle length inputs made by the user (not 25 and 40 feet). Thus, Models 7 and 8 are called the 'Enhanced' SIGNAL97 models (S97E+ and S97A+).

Model 10 is the queue model produced by the SIGNAL97 ANALYZE command and displayed in the Capacity Analysis Summary report of SIGNAL97. This formulation does not account for oversaturated conditions, but merely the number of arrivals expected during the red time. The fixed randomness factor of 2.0 approximates this queue length within a 90 percent level of confidence. The formula used is listed below. Note that in SIGNAL97 the Q_n portion of the model is not on a per-lane basis (divided by N) as it is in SIGNAL2000. The SIGNAL2000 model divides by N for a per-lane value so it can be compared to the 2000 HCM models which are all on a per-lane basis.

$$Q_n = 2.0 * q * r / N$$

where:

Q_n	= number of vehicles in queue per lane
2.0	= 90th percentile randomness factor (poisson distribution estimate)
q	= arrival rate (vehicles per second)
	= v/3600
v	= adjusted volume (vehicles per hour)
r	= time that is not effectively green (seconds), e.g., "effective red time"
	= C * (1-g/C)
C	= cycle length (seconds)
g	= effective green time (seconds)
N	= number of lanes in lane group

When the subject movement is a protected-permitted left turn, the q*r portion of the formula is obtained from the Supplemental Delay Worksheet using the largest such value from the worksheet.

$$Q_l = L_c * T_f * Q_n$$

where:

Q_l	= length of queue per lane(feet)
L_c	= average queued spacing between car front bumpers (feet)
	= 25 feet, constant for Model 9 and 10
Q_n	= number of vehicles in queue per lane (from above)
T_f	= truck length factor
	= $1 + (L_t/L_c - 1) * HV/100$
L_t	= average spacing between truck front bumpers (feet)
	= 40 feet, constant for Model 9 and 10
HV	= percent trucks/heavy vehicles (%)

Model 8 is the same queue model as Model 10 above, with the exception that it calculates the percentile queue for the percentile input by the user based on actual cumulative Poisson arrival probabilities (not a 2.0 factor), and the queue distances are estimated using the queued vehicle

length inputs made by the user (not 25 and 40 feet), and thus it is called the 'Enhanced' SIGNAL97 ANALYZE model (S97A+).

Models 9 is the queue model produced by the SIGNAL97 EVALUATE command and displayed in the Evaluation of Intersection Performance report of SIGNAL97. When conditions are undersaturated, the model is the same as Model 10 above. However, when conditions are over-saturated ($X > 1.0$), the following formula is used for Q_n to account for number of over-saturated arrivals in the analysis period. Note that in SIGNAL97 the Q_n portion of the model is not on a per-lane basis (divided by N) as it is in SIGNAL2000. The SIGNAL2000 model divides by N for a per-lane value so it can be compared to the 2000 HCM models which are all on a per-lane basis.

$$Q_n = [2.0 * q * r + T * v * (X-1)] / [X * N]$$

where:

Q_n	=	number of vehicles in queue per lane
2.0	=	90th percentile randomness factor (poisson distribution estimate)
q	=	arrival rate (vehicles per second)
	=	v/3600
v	=	adjusted volume (vehicles per hour)
r	=	time that is not effectively green (seconds), e.g., "effective red time"
	=	C * (1-g/C)
C	=	cycle length (seconds)
g	=	effective green time (seconds)
T	=	length of analysis period (hours)
X	=	v/c = Volume/Capacity ratio
c	=	capacity (vehicles per hour)
N	=	number of lanes in lane group

As with Model 10 (ANALYZE), when the subject movement is a protected-permitted left turn, the q*r portion of the formula is obtained from the Supplemental Delay Worksheet using the largest such value from the worksheet.

Model 7 is the same queue model as Model 9 above, with the exception that it calculates the percentile queue for the percentile input by the user based on actual cumulative Poisson arrival probabilities (not a 2.0 factor), and the queue distances are estimated using the queued vehicle length inputs made by the user (not 25 and 40 feet), and thus it is called the 'Enhanced' SIGNAL97 EVALUATE model (S97E+).

Important Differences Between SIGNAL85 and SIGNAL2000

Several differences between SIGNAL85 and SIGNAL2000 (as well as between SIGNAL85 and both SIGNAL94 and SIGNAL97) are important to note for prior users of SIGNAL85. Further, because of the inherent compatibility between SIGNAL85, SIGNAL94, SIGNAL97 and SIGNAL2000 and the evolution of the 1985 *Highway Capacity Manual* (HCM) to the 2000 HCM, a common effort will be to re-execute analyses that were previously done with

SIGNAL85, SIGNAL94 or SIGNAL97 with the SIGNAL2000 program. This is easily accomplished due to the upwards compatibility of data files between the programs using the File-OpenMerge/Shared menu (or the LOAD * SHARE command), but several points are worth making to help guide this process. The following discusses these issues.

New Default Values

Several input variables have new default values in SIGNAL94, SIGNAL97 and SIGNAL2000 in comparison to SIGNAL85. These new defaults are consistent with the default values suggested by the 1994, 1997 and 2000 HCMs. For a new analysis, these variables take on their new default values automatically when the analysis starts, but this is not true when a SIGNAL85 data file is Opened or LOADed. This is because the default values from SIGNAL85 are stored in the data file along with other user entries, and thus will be LOADed as real data, thus over-riding the SIGNAL2000 defaults. The five command entries which are affected in this way are IDEALSATFLOWS, UTILIZATIONS, ARRIVALTYPES, REQCLEARANCES and PEDLEVELS. IDEALSATFLOWS now default to 1900 pcphgpl instead of 1800, UTILIZATIONS now default to 0.0 instead of 1.0 so that the HCM defaults are used, ARRIVALTYPES now default to type 3 for all movements (including left turns), REQCLEARANCES now default to 4.0 seconds instead of 3.0, and PEDLEVELS default to 0 peds per hour instead of LOW (which equals 50 per hour). If the SIGNAL2000 defaults are desired for a SIGNAL85 analysis LOADed from a SIGNAL85 file, they must be specifically set to their default values in some fashion to over-ride the old defaults read from the SIGNAL85 file.

The easiest way to do this is to use the RESET command for the commands whose values are to be set to their 1994/1997/2000 HCM defaults. For example, if the IDEALSATFLOWS and UTILIZATIONS are to be set to 1994/1997/2000 HCM defaults after a SIGNAL85 file is LOADed, issuing the following command will accomplish this:

[DATAFILES] → **RESET IDEALS UTILIZ**

If all of the five commands mentioned above are to be reset to the 1994/1997/2000 HCM defaults, the following command makes this even easier:

[DATAFILES] → **RESET [94DEFAULTS]**

[94DEFAULTS] is a special group name designed for just this purpose which represents the list of the five commands mentioned above. Note also that the group name in the RESET command can be abbreviated in most any way, such as simply RESET [94]. The user must take care that this is the correct action for the specific analysis being conducted.

Use of SERVICEVOLUMES and GOVERCS Commands

Another significant change brought about by the new 1994/1997/2000 HCM methods is that saturation flow rates and g/C requirements can no longer be specified independently of the specific phasing and timings which are being used at an intersection. For example, the satflow of a permitted left turn is now explicitly dependent both on the phasing of the opposing through movement and the timing of that phasing. With regards to SIGNAL2000, this means that the SERVICEVOLUMES and GOVERCS commands are no longer independent of the phasing and timings (as they were in SIGNAL85), and now require specific SEQUENCES, GREENTIMES and YELLOWTIMES entries to be made before they can be run. In this sense SERVICEVOLUMES and GOVERCS must be used in the Analyze Mode like ANALYZE and EVALUATE, instead of the Design Mode like DESIGN.

Calculating and Saving Saturation Flow Rates

In the same line of discussion as the previous paragraph, saturation flow rates can no longer be calculated by the DESIGN process alone for the SATURATIONFLOWS command to be SAVEd in a file. This is because DESIGN may not know a specific phasing or timings for which these satflows should be calculated, since it is generally optimizing a wide range of phasings and cycle lengths. Thus, now an Analyze Mode command such as ANALYZE, EVALUATE, QUEUECALCS, SERVICEVOLUMES or GOVERCS must be issued before new SATURATIONFLOWS are calculated to be SAVEd. Note that the SATURATIONFLOWS which are calculated for left turns reflect the type of phasing used: for protected or protected-permitted phasings the SATFLOWS reflect the protected-phase satflows, while a permitted-only phasing calculates the permitted satflows. This is consistent with the SATFLOWS values expected by PREPASSR, PRETRANSYT and PRENETSIM.

Processing Time for DESIGN

Prior users of SIGNAL85 may note that SIGNAL2000 can take a considerably longer time to effect a complete DESIGN optimization, particularly when saturated conditions and/or permitted phasings are allowed. This is due to the substantially more complex dependence of optimum phase times on the timing and phasing of other movements at the intersection involved in the 1994/1997/2000 HCM methodology, and is unavoidable. Optimization times will be very manageable on typical computers using current technology, but can be much longer on less modern computers. The following offers several options to speed things up in these cases.

Cycle length limits and increments should be selected judiciously since the amount of optimization time is directly proportional to the number of cycles attempted. Arbitrarily small increments of CYCLES should be avoided unless specifically necessary. For example, 40..140..10 will deliver virtually the same information as 40..140..5 in one half the time.

If permitted-only operation is specifically not acceptable in certain situations for safety and/or policy reasons, optimization time can be significantly improved by eliminating sequence codes 1, 2 and 3 from the SEQUENCES list. For example, in a fully-actuated signal where all left turn phases are expected to be actuated on the average, selecting the following SEQUENCES list will

speed up the DESIGN process while at the same time eliminating permitted-only operation on any approach.

[Basic] → **SEQUENCES 44 45 46 54 55 56 64 65 66**

or

[Basic] → **SEQUENCES 44 CC**

Important Differences Between SIGNAL2000 Ver 1 and Ver 2

Several differences between SIGNAL2000 Version 1 and Version 2 are important to note for prior users of Version 1. These differences also apply to older SIGNAL programs (SIGNAL85, SIGNAL94, SIGNAL97) if a user has occasion to read these older data files into Version 2. Reading data from any of these older programs, including Version 1, is easily accomplished due to the upwards compatibility of data files between the programs using the File-OpenMerge/Shared menu (or the LOAD * SHARE command), but several points are worth making to help guide this process. The following discusses these issues.

Managing Multiple Intersections with NODELIST and INTERSECTION

All prior versions of SIGNAL handled a single intersection in an analysis and File-Save placed this single intersection in a single data file, resulting in a large number of data files and independent analyses for projects with multiple intersections and/or multiple scenario conditions. This was dictated by the methods of the *Highway Capacity Manual* (HCM) and the historical way of managing data for HCM analyses.

SIGNAL2000 Version 2 has the same data structure as PRENETSIM, PRETRANSYT and PREPASSR, in that multiple intersections can be entered and stored in a single data file. The list of intersections is managed with a NODELIST entry which lists all the available intersection numbers which have been used, and the INTERSECTION entry which selects the 'current' intersection from the NODELIST. The current intersection is the one for which data entry will be accepted and for which analysis functions like DESIGN and ANALYZE will be made. The current intersection can be selected by using the drop down list in the INTERSECTION dialog again, or by 'walking' through the NODELIST with the +/- buttons found on the main toolbar and relevant entry dialogs. The current intersection is displayed in the status bar at the bottom of the main window.

New intersections can be added to the network by first adding it with the NODELIST dialog, then selecting it from the INTERSECTION drop-down list (or typing it in the INTERSECTION combo box). As a shortcut, the new intersection number can be typed (with a description) in the

INTERSECTION combo box, in which case the user will be prompted with an option to add the intersection to the end of the NODELIST automatically.

INTERSECTION 0 is a selection which represents all intersections in the NODELIST. When this is selected, certain actions like ANALYZE and DESIGN 1 will be performed for all intersections. Certain other actions like SORT, TIMINGS and EXPORT are not valid when INTERSECTION 0 is selected, as these actions can pertain to only a single intersection.

Usage Level 1 of SIGNAL2000 will only perform a capacity analysis for a single intersection. Usage Level 2+ of SIGNAL2000 includes the optimization feature. Usage Level 2 handles up to 12 intersections, Usage Level 3 is up to 100, and Usage Level 4 is up to 500.

Several additional entries assist in managing the activities which surround multi-intersection analyses. In Usage Level 3 and above, the SUBSYSTEM entry can be used to select a group of intersections which is a subset of the NODELIST for subsequent analysis when INTERSECTION 0 is selected. A ROUTE entry can also be used to define up to 8 predefined subsets, usually, but not limited to arterial routes, which can then be used as shortcuts in the SUBSYSTEM entry by entering the negative route number.

Merging Multiple Version 1 Files Into a Single Version 2 File

Since prior versions of SIGNAL2000 (and SIGNAL97, SIGNAL94, etc.) handled a single intersection in each data file, in many cases it will be desirable to merge all of these files into a single file in SIGNAL2000 Version 2. This can be done quite easily by opening each prior file using the File-OpenMerge/Shared menu, as long as each of the intersections loaded uses a different intersection number or no number at all (in which case you will be prompted to enter a number). The list of intersection numbers to be used can be entered in the NODELIST in advance of the OpenMerge/Shared, or the user will be prompted to automatically add each intersection number to the end of the NODELIST as new numbers are encountered. When all intersections have been loaded, use File-SaveAs to save the single combined file into a new file name. If OpenMerge/Shared is not used, the possibility of losing all data previously entered into Version 2 exists due to the way the older versions initialized the older programs; if Version 1 files are being Opened, this condition is detectable and a warning is issued to that effect.

Processing Time for DESIGN

LEVELOFSERVICE has been enhanced significantly so that more precise delay targets can be specified, and the incremental delays tested are user-controlled for more precise balancing of the critical delays when the target cannot be met. In addition, if none of the delay targets are met, a more precise incremental v/c testing is also user controlled. All of this enhanced precision in the optimization results in noticably superior optimization results, but comes with a price tag in terms of computational time. Further, several important new calculations have been added to portions of the optimization iterations which generate better results, but at the further expense of additional computational time.

On today's faster computers, this additional time may not be significant or even noticable. On older computers, however, depending on the number of SEQUENCES and CYCLES being tested, as well as the degree of saturation of the intersection's critical movements, certain calculations may take more time than expected or desired. In these cases, judicious selection of the target delay and delay optimization increment (LEVELOFSERVICE), the list of allowed phasings (SEQUENCES) and the cycle optimization increment (CYCLES) can have a noticable impact on the net optimization time. If it appears an optimization will take longer than desired and flexibility exists for selecting new values for these variables, an optimization can be aborted and re-started after changing the appropriate inputs.

HCM Sample Problems

Included on the distribution disk with SIGNAL2000 are data files for the operations method sample calculations from Chapter 16 of the 2000 *Highway Capacity Manual*. The file names are coded as SCx.FOR, where "x" is the sample calculation problem number (1, 2 and 3). For example, SC1.FOR is the data file for sample calculation #1. Each one of the data files can be LOADed and then run by issuing the ANALYZE command, producing the worksheets and capacity analysis summary which match the results found in the 2000 HCM.

Another related data file is included with the sample data files called SCX.FOR. This is a small control file which can be used to LOAD and EXECUTE each of the sample calculations in succession. It is executed by simply opening it, or by naming it as FILE #1 and LOADing it.

APPENDIX D

Report Descriptions and Examples

Appendix D Topics

This appendix describes each of the major output reports which can be produced by the SIGNAL2000 program. The reports are discussed, followed by an example output, in the order indicated in Table D-1. The table includes the report title and the primary command associated with the contents of the report. The report title and primary command for each report appear at the top of each page of the appendix for easy reference.

Each of the outputs presented in this appendix was created using the example data included in the sample file named SIGNAL20.FOR. These results can be re-created by opening this file (found in the installed program folder) and executing a LOAD command with default parameters from the File-Datafiles menu. The reports shown here are the text-only versions of the output in order to reduce the size of the downloadable programs, demos, updates, help files and .pdf manuals. Using the LOAD command above will, by default, produce the far superior-looking graphical output reports whose inclusion herein would vastly increase the size of the downloads mentioned.

Opening the file reads in the basic data for the examples of this appendix. The LOAD command will produce the output reports contained in this appendix by reading a control file script stacked in the file after the input data. This procedure is a good way to verify the operation of the program, as well as to create a starting point for further experimentation with the SIGNAL2000 program. The data used in the example outputs is summarized in the first output example, Summary of Parameter Values. Each report description that follows includes all of the commands which can be used to generate the report.

Table D-1
Report Descriptions and Examples

Report Title	Keyword
Summary of Parameter Values	SUMMARISE
Optimized Phase Sequences	DESIGN
Optimum Phasings Ranked by Delay	SORT
Optimum Phase Timings	TIMINGS
2000 Highway Capacity Manual Worksheets	ANALYZE
- HCM Input Worksheet	ANALYZE
- HCM Volume Adjust & Satflow Worksheet	ANALYZE
- HCM Supplemental LT-Factor Worksheet	ANALYZE
- HCM Ped-Bike LT Effects Worksheet	ANALYZE
- HCM Ped-Bike RT Effects Worksheet	ANALYZE
- HCM Capacity and LOS Worksheet	ANALYZE
- HCM Supplemental Uniform Delay Worksheet	ANALYZE
- HCM Initial Queue Delay Worksheet	ANALYZE
- HCM Back of Queue Worksheet	ANALYZE
Capacity Analysis Summary	ANALYZE
Evaluation of Intersection Performance	EVALUATE
Queuemodel Calculations	QUEUECALCS
Required g/Cs and LT Clearance Cycles	GOVERCS
Satflow Rates and LT Clearance Cycles	SERVICEVOLUMES
Display of Intersection Parameters	MAP
Diagram of Signal Phasing	DIAGRAMS

Appendix D Topics

SIGNAL2000/TEAPAC - Capacity Analysis Summary
SIGNAL2000/TEAPAC - Evaluation of Intersection Performance
SIGNAL2000/TEAPAC - Queuemodel Calculations
SIGNAL2000/TEAPAC - Required g/Cs and LT Clearance Cycles
SIGNAL2000/TEAPAC - Satflow Rates and LT Clearance Cycles
SIGNAL2000/TEAPAC - Display of Intersection Parameters
SIGNAL2000/TEAPAC - Diagram of Signal Phasing

SIGNAL2000/TEAPAC - Summary of Parameter Values

The Summary of Parameter Values report generated by the SUMMARISE command is a compilation of data pertinent to analyzing intersection capacity by lane group, recognizing all of the quantifiable parameters as described in the 2000 *Highway Capacity Manual*. The parameters are discussed below by the groups in which they appear. If all intersections are selected (INTERSECTION 0), then the initial portion of the report lists all the system parameters, followed by the parameters for each intersection in the system. If a single intersection is selected, only the parameters for that intersection are listed.

System Parameters

This section lists parameters which apply to the entire system. The Queuemodels entries list, in order, the selected queue model number, the percentile queue desired, the storage length of queued automobiles, and the storage length of queued trucks. The Output entries list, in order, the selected level of capacity analysis worksheet output, whether certain warning messages will be displayed, and the selected level of DESIGN and EVALUATE output. The simulation period is the length of the analysis period used for each intersection. It is followed by parameters maintained for PRETRANSYT and PREPASSR, but of no consequence for SIGNAL2000, regarding simulation steps, use of the actuated model, the link assignment, and optimization type. This is followed by the list of intersections in the network, the master node number, and any intersections in a defined subsystem and any defined routes.

Intersection Parameters

This section lists parameters which apply to the entire intersection, including the intersection number and description and its location within the metropolitan area. The level of service target entries identify the desirable operating levels of performance for critical movements (delay in seconds and v/c in percent), and the worst levels to be tested, as well as the optimization increments. The priorities list the movements which get priority treatment if the level of performance target is met. The network location lists, in order, the distance (feet), speed (mph) and upstream node number for each approach of the intersection. The next four numbers of the network location identify which movement numbers of the upstream nodes supply traffic to the subject intersection. The last three network entries describe the upstream link assignment method, the link curvature, and if the link distance has been manually entered. The node location lists the X and Y coordinates, respectively, of the intersection's location in the system network.

Approach Parameters

These are the parameters which apply uniquely to each of the four approaches. They include individual approach labels, percent of approach grade (negative numbers are downhill approaches), pedestrian interference levels for right turns on each approach (in peds per hour), bicycle volumes interfering with right turns on each approach (in bikes per hour), parking location and volume on each leg of the intersection, bus stop frequency (in buses per hour), how many right turns are made on a red indication per hour, and the v/c of the upstream intersection.

Movement Parameters

These are the parameters which are applied individually to each of the 12 movements. They include movement labels, traffic demand volumes (vehicles per hour), lane group width (feet), number of lanes in each lane group and factors indicating the lane utilization for each movement. Widths and lanes given for turning movements indicate exclusive turning lanes; widths for through directions are used by straight vehicles as well as turning vehicles without exclusive tuning lanes. Each movement's group type indicates any special lane group type such as dual-optional turn lanes and free-flow lanes. Utilization values of 0.0 indicate that the HCM default values will be used. Also listed are truck percentages, peak hour factors, arrival types and actuated condition of each possible movement. Arrival types are usually the types 1-6, but may also represent the HCM-defined PVG or RP values. Required clearance intervals and minimum timings for green indications are listed, as well as startup lost times and end gain times, all in seconds. The length of storage available for queued vehicles is listed, in feet, and the initial number of queued vehicles at the start of the analysis period is listed. The ideal saturation flows are listed by movement, as are the adjustment factors used for calibrating the satflow, delay and stops calculations. The calculated saturation flow rate in vphg is also listed; left turn satflows assume protected phasing if the left turn is a protected-permitted operation.

Phasing Parameters

The last section of the report lists parameters which relate to the phasing of the intersection. First the basic phasing sequence code is listed, either as a specific phasing, a list of possible phasings, or the keyword ALL representing all possible phasings being allowed. When ALL is shown, the primary phasing code is also shown. The next entries indicate if left turns are permitted on a green ball following or preceding an exclusive phase (permitted left condition) and whether right turns are allowed to overlap into adjacent protected left turn phases when exclusive right turn lanes exist.

Following this is the cycle length and range to be used for cycle optimization. If phase timings are provided in seconds/second, then the first cycle value is used to convert these timings to seconds before analysis (otherwise it is ignored in an analysis). In a cycle optimization, the first cycle is the lowest cycle to be tested, the second is the highest cycle to be tested, and the third entry is the increment of cycle time to be used to move from the lowest to the highest cycle. Individual phases greentimes and yellowtimes are then listed in seconds or seconds/second, for each phase, in the order of the phasing specified. Yellowtimes include all-red clearance times as well. The critical movements used for designing timings for each phase are also listed, if they have been determined. The right side of this section identifies whether the sequence codes appear in their normal order (LEAD or NONE), or are reversed (LAG), as well as the system offset and exclusive pedestrian phase time (scramble phase). The offset indicates which phase has the given offset, and the ped phase shows which phase the exclusive ped phase follows.

The following is an example of the Summary of Parameter Values text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report

contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - Summary of Parameter Values

System Parameters
=================

Queues:  Model # 1,  Percentile 90,  Auto spacing 25,  Truck spacing 40
Output:  Worksheets-None   Messages-Yes  Design details-None

Simulation Period of 15 minutes,  300 Steps per TRANSYT Cycle
Use T7F/PSR actuated model? No,   Default link assignment method: Full
T7F/PSR Optimization Type: None   w/  0  0  0  2  0  0  0  0  0  0  0  0  0  0  0

List of Intersection #'s in Network: (Master Node is   1)
            1


SIGNAL2000/TEAPAC[Ver 2.71.07] - Summary of Parameter Values

   Intersection Parameters for Int #   1 - Lincoln & Main
METROAREA           NonCBD     NETWORK  North   388 30 999  2  6 10  0 Def N N
LOS Targets      35  80   5    NETWORK  East    287 30 998  5  9  1  0 Def N N
                 90 100   5    NETWORK  South   273 30 997  8 12  4  0 Def N N
Priorities   0  0  0  0  0  0  NETWORK  West    241 30 996 11  3  7  0 Def N N
                               NODELOCATION              0           0
   Approach Parameters
APPLABELS                N               E               S                W
GRADES                 0.0             0.0             0.0              0.0
PEDLEVELS               10               0              10                0
BIKEVOLUMES              0               0               0                0
PARKINGSIDES          None            None            None             None
PARKVOLUMES             20              20              20               20
BUSVOLUMES               0               0               0                0
RIGHTTURNONREDS          0               0               0                0
UPSTREAMVC            0.00            0.00            0.00             0.00

   Movement Parameters
MOVLABELS           RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT
VOLUMES            175  550  125    60  425   65    65  370  200   215  450  220
WIDTHS            12.0 24.0 12.0   0.0 24.0 12.0   0.0 24.0 12.0  12.0 24.0 12.0
LANES                1    2    1     0    2    1     0    2    1     1    2    1
GROUPTYPES        Norm Norm Norm  Norm Norm Norm  Norm Norm Norm  Norm Norm Norm
UTILIZATIONS      0.00 0.00 0.00  0.00 0.00 0.00  0.00 0.00 0.00  0.00 0.00 0.00
TRUCKPERCENTS      2.0  2.0  2.0   2.0  2.0  2.0   2.0  2.0  2.0   2.0  2.0  2.0
PEAKHOURFACTORS   0.90 0.90 0.90  0.90 0.90 0.90  0.90 0.90 0.90  0.90 0.90 0.90
ARRIVALTYPES         3    3    3     3    3    3     3    3    3     3    3    3
ACTUATIONS          No   No   No    No   No   No    No   No   No    No   No   No
REQCLEARANCES      4.0  4.0  4.0   4.0  4.0  4.0   4.0  4.0  4.0   4.0  4.0  4.0
MINIMUMS           5.0  5.0  5.0   5.0  5.0  5.0   5.0  5.0  5.0   5.0  5.0  5.0
STARTUPLOST        2.0  2.0  2.0   2.0  2.0  2.0   2.0  2.0  2.0   2.0  2.0  2.0
ENDGAIN            2.0  2.0  2.0   2.0  2.0  2.0   2.0  2.0  2.0   2.0  2.0  2.0
STORAGE            100 1000  250     0 1000  250     0 1000  250   100 1000  250
INITIALQUEUE         0   10    0     0    0    0     0   10    0     0    0    0
IDEALSATFLOWS     1900 1900 1900  1900 1900 1900  1900 1900 1900  1900 1900 1900
FACTORS           1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00
DELAYFACTORS      1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00
NSTOPFACTORS      1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00
SATURATIONFLOWS      0    0    0     0    0    0     0    0    0     0    0    0

   Phasing Parameters
SEQUENCES           11
PERMISSIVES        Yes      No    Yes     No          LEADLAGS       None   None
```

```
OVERLAPS              Yes    Yes    Yes    Yes         OFFSET          0.00      1
CYCLES                 60    120     30                PEDTIME          0.0      0
GREENTIMES          56.00  56.00
YELLOWTIMES          4.00   4.00
CRITICALS               0      0
```

SIGNAL2000/TEAPAC - Optimized Phase Sequences

As the program proceeds with the operational design of each of the specified phasings, the Optimized Phase Sequences report is produced by the DESIGN command to inform the user of the progress of the design. Each phasing is tested at all specified cycle lengths in an attempt to make the critical movements of the phasing work at the best possible balanced level of service.

In the short report, a table of the critical movement levels of service is produced where each row represents all of the critical levels of service achieved for each phasing at the listed cycle length. The column heading at the top shows each two-digit phasing code below which are the levels of service achieved for that phasing at each cycle length. The order of the phasings across the top of the table are not significant, except that they are listed in the order in which they are solved, as taken from the SEQUENCES command. If the SEQUENCES 11 ALL entry is used, the table will be in numerical order from 11 to 88. The columns of results in this table are always listed in groups of eight for ease of reading.

A more detailed report can be selected with the OUTPUT * * DETAIL command. This report also lists the target design value which was achieved for each combination of sequence and cycle, and reverses the axes of the table to accomplish this for as many as 11 cycle columns in each table. As many tables as needed are produced to accommodate the requested cycle range and increment.

Either report format is terminated with a list of the design criteria which were used in the DESIGN. This includes the target delay (seconds), the maximum delay, the delay increment, the target v/c (percent), the maximum v/c and the v/c increment.

Additional calculations may be shown in this report by using the OUTPUT * * EXTRA command. These describe how the optimization is achieved with detailed timing requirements for each of the standard phase types. This output is normally not generated.

The following is an example of the Optimized Phase Sequences text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

SIGNAL2000/TEAPAC[Ver 2.71.07] - Optimized Phase Sequences

Intersection #   1 - Lincoln & Main

```
    Seq (**/**)
    11111111 22222222 33333333 44444444 55555555 66666666 77777777 88888888
Cyc 12345678 12345678 12345678 12345678 12345678 12345678 12345678 12345678
=== ======== ======== ======== ======== ======== ======== ======== ========
 60 CDCDDCDC DSDDDDDD CDCCCCCC CDCCCCCC CDCCCCCC CDCCCCCC DEDDDDDD CDCCCCCC
 90 CDDDDDDD DDDDDDDD CDDDDDDD CDDDDDDD CDDDDDDD CDDDDDDD DDDDDDDD DDDDDDDD
120 DEDDDDDD DEDDDDDD DDDDDDDD CDDDDDDD CDDDDDDD CDDDDDDD DEDDDDDD DDDDDDDD
```

Design Criteria: 35   80   5   90 100   5

SIGNAL2000/TEAPAC[Ver 2.71.07] - Optimized Phase Sequences - Detail

Intersection #   1 - Lincoln & Main

```
 Seq   Cycle
**/**     60     90    120
===== ====== ====== ======
  11    35-C   35-C   40-D
  12    55-D   50-D   60-E
  13    35-C   45-D   50-D
  14    40-D   45-D   50-D
  15    40-D   45-D   50-D
  16    35-C   45-D   50-D
  17    40-D   45-D   50-D
  18    35-C   45-D   50-D
  21    50-D   40-D   45-D
  22  1.01-S   55-D   60-E
  23    55-D   45-D   50-D
  24    55-D   50-D   55-D
  25    55-D   50-D   55-D
  26    55-D   45-D   50-D
  27    55-D   45-D   55-D
  28    55-D   45-D   50-D
  31    35-C   35-C   40-D
  32    45-D   45-D   50-D
  33    35-C   40-D   45-D
  34    35-C   40-D   45-D
  35    35-C   40-D   45-D
  36    35-C   40-D   45-D
  37    35-C   40-D   45-D
  38    35-C   40-D   45-D
  41    35-C   35-C   35-C
  42    40-D   45-D   50-D
  43    35-C   40-D   45-D
  44    35-C   40-D   45-D
  45    35-C   40-D   45-D
  46    35-C   40-D   45-D
  47    35-C   40-D   45-D
  48    35-C   40-D   45-D
  51    35-C   35-C   35-C
  52    40-D   45-D   50-D
  53    35-C   40-D   45-D
  54    35-C   40-D   45-D
  55    35-C   40-D   45-D
  56    35-C   40-D   45-D
  57    35-C   40-D   45-D
```

```
  58    35-C   40-D   45-D
  61    35-C   35-C   35-C
  62    40-D   45-D   50-D
  63    35-C   40-D   45-D
  64    35-C   40-D   45-D
  65    35-C   40-D   45-D
  66    35-C   40-D   45-D
  67    35-C   40-D   45-D
  68    35-C   40-D   45-D
```

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - Optimized Phase Sequences - Detail

  71    40-D   45-D   50-D
  72    70-E   55-D   60-E
  73    45-D   45-D   55-D
  74    45-D   50-D   55-D
  75    45-D   50-D   55-D
  76    45-D   45-D   55-D
  77    45-D   50-D   55-D
  78    45-D   45-D   55-D
  81    35-C   40-D   45-D
  82    45-D   45-D   55-D
  83    35-C   40-D   50-D
  84    35-C   45-D   50-D
  85    35-C   45-D   50-D
  86    35-C   40-D   50-D
  87    35-C   40-D   50-D
  88    35-C   40-D   50-D

Design Criteria:    35   80    5   90  100    5
```

SIGNAL2000/TEAPAC - Optimized Phasings Ranked by Crit Delay

The Optimized Phasings report generated by the SORT command, provides a valuable tool which can be used in making phasing selections and cycle selection. This report is also an optional (default) output of the DESIGN command. The sorted order reflects a powerful way of identifying which phasings have the highest probability of being successful - those with the lowest overall percentage of cycle time required at the best critical movement level of service and target delay achieved. This is the order in which the sequences are sorted - first by critical LOS achieved, then by target delay achieved within this LOS, then by required G/C + Y/C. If two sequences have the same required G/C + Y/C at the same level, they are further sorted by the best cycle length found and then the number of phases. All of this information is documented for each sequence code which is feasible. Infeasible sequences are listed in a matrix at the end of the report. This means that the phasing is considered unsafe and/or inappropriate for the specified input conditions.

When a phasing will not work at the maximum delay allowed, v/c balancing is attempted with the target v/c range provided. In this case a critical LOS of V is displayed along with the target v/c (%). If a solution is still not found, the phasing is listed with a critical LOS of S indicating that a saturated design was performed. This means that the design was forced based on the last v/c tested. "Optimum" timings can be obtained for these LOS S phasings, but should be inspected carefully to make sure that an appropriate balance of time and delay has been provided. The required G/C + Y/C for LOS S conditions indicates the v/c ratio of the critical movements which can be achieved by the design, similar to the critical v/c calculation of the HCM.

The minimum cycle length which accommodates the phasing and all minimums is listed. The range of cycles which were found to be successful at the specified level of service is documented as the last item in the report. The column heading for this information shows the range and increment of cycles tested.

The report is terminated with a list of the design criteria which were used in the DESIGN. This includes the target delay (seconds), the maximum delay, the delay increment, the target v/c (percent), the maximum v/c and the v/c increment.

The following is an example of the Optimized Phasings Ranked by Crit Delay text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

SIGNAL2000/TEAPAC[Ver 2.71.07] - Optimized Phasings Ranked by Crit Delay

Intersection # 1 - Lincoln & Main

Seq **/**	Crit LOS	Crit Targ	Req'd G/C+Y/C	Best Cycle	No. of Phases	Min Cycle	Succ--Cycles 60..120(30)
61	C	35	0.900	60	4	27	60..120
41	C	35	0.904	60	3	27	60..120
51	C	35	0.904	60	4	27	60..120
31	C	35	0.923	60	3	27	60.. 90
81	C	35	0.924	60	4	27	60.. 60
11	C	35	0.947	60	2	18	60.. 90
66	C	35	0.954	60	6	36	60.. 60
68	C	35	0.954	60	6	36	60.. 60
44	C	35	0.955	60	4	36	60.. 60
47	C	35	0.955	60	4	36	60.. 60
43	C	35	0.955	60	4	36	60.. 60
45	C	35	0.955	60	5	36	60.. 60
54	C	35	0.955	60	5	36	60.. 60
63	C	35	0.955	60	5	36	60.. 60
57	C	35	0.955	60	5	36	60.. 60
46	C	35	0.955	60	5	36	60.. 60
64	C	35	0.955	60	5	36	60.. 60
53	C	35	0.955	60	5	36	60.. 60
48	C	35	0.955	60	5	36	60.. 60
67	C	35	0.955	60	5	36	60.. 60
55	C	35	0.955	60	6	36	60.. 60
65	C	35	0.955	60	6	36	60.. 60
58	C	35	0.955	60	6	36	60.. 60
56	C	35	0.955	60	6	36	60.. 60
33	C	35	0.973	60	4	36	60.. 60
34	C	35	0.973	60	4	36	60.. 60
37	C	35	0.973	60	4	36	60.. 60
36	C	35	0.973	60	5	36	60.. 60
35	C	35	0.973	60	5	36	60.. 60
38	C	35	0.973	60	5	36	60.. 60
83	C	35	0.974	60	5	36	60.. 60
86	C	35	0.974	60	6	36	60.. 60
88	C	35	0.974	60	6	36	60.. 60
87	C	35	0.991	60	5	36	60.. 60
84	C	35	0.995	60	5	36	60.. 60
85	C	35	0.995	60	6	36	60.. 60
13	C	35	0.999	60	3	27	60.. 60
16	C	35	0.999	60	4	27	60.. 60
18	C	35	0.999	60	4	27	60.. 60
17	D	40	0.976	60	3	27	60..120
14	D	40	0.978	60	3	27	60..120
15	D	40	0.978	60	4	27	60..120
71	D	40	0.986	60	3	27	60..120
42	D	40	0.996	60	4	36	60..120
52	D	40	0.996	60	5	36	60..120
62	D	40	0.996	60	5	36	60..120
21	D	40	1.000	90	3	27	60..120
82	D	45	0.976	60	5	36	60..120
32	D	45	0.977	90	4	36	60..120

73	D	45	0.983	60	4	36	60..120
78	D	45	0.983	60	5	36	60..120
76	D	45	0.983	60	5	36	60..120
23	D	45	0.983	90	4	36	60..120
28	D	45	0.983	90	5	36	60..120
26	D	45	0.983	90	5	36	60..120
74	D	45	0.998	60	4	36	60..120
75	D	45	0.998	60	5	36	60..120
77	D	45	0.999	60	4	36	60..120
27	D	45	0.999	90	4	36	60..120
24	D	50	0.962	90	4	36	60..120
25	D	50	0.962	90	5	36	60..120
12	D	50	0.984	90	3	27	60.. 90
72	D	55	0.973	90	4	36	90.. 90
22	D	55	0.982	90	4	36	90.. 90

Design Criteria: 35 80 5 90 100 5

SIGNAL2000/TEAPAC - Optimum Phase Timings

The Optimum Phase Timings report generated by the TIMINGS command provides a list of the optimum phase times which have been generated by the DESIGN command. These phase times are shown in both seconds (G and Y+R) and seconds per second (G/C) for the cycle length shown. The optimum phase times have been adjusted so that the total G/C + Y/C equals 1.0 by allocating excess time (if any exists) to the defined priority movements. The critical movement in each phase is indicated in the phase diagram with asterisks in the movement arrows. The sequence code for the phasing is listed in the upper-left corner of the results, with the Lead/Lag conditions below, if any. If a phase's green time is controlled by a minimum, this is indicated by the letter M in the lower left corner of the phase.

The following is an example of the Optimum Phase Timings text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - Optimum Phase Timings

Intersection #   1 - Lincoln & Main

      -------------------------------------------------
Sq 44 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |
**/** -------------------------------------------------
      |     +     | + * +     | +         |       ^   |
  .   |     +     | + * +     | +         |       ****|
 /|\  |     +>    |<+ * +>    |<+         |      <****|
  |   |           |   v       |   ^   ++++|           |
  |   |           |       ^   |****   v   |           |
North |    <*     |    <+ + +>|           |++++>      |
  |   |++++ *     |     + + + |           |++++       |
      |   v *     |     + + + |           |   v       |
      -------------------------------------------------
      | G/C=0.092 | G/C=0.237 | G/C=0.204 | G/C=0.200 |
C= 60"| G=   5.5" | G=  14.2" | G=  12.3" | G=  12.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
      -------------------------------------------------
```

SIGNAL2000/TEAPAC - HCM Input Worksheet

The 2000 *Highway Capacity Manual* describes nine worksheets for simplifying and organizing capacity analysis calculations. Replicas of these worksheets may be produced by the ANALYZE, EVALUATE or QUEUECALCS commands by first setting the first OUTPUT parameter to FULL. A limited set of only the basic HCM worksheets can be produced by setting the first OUTPUT parameter to BASIC. Worksheets may also be produced by DESIGN with the same OUTPUT setting if a capacity analysis has been requested following the design.

Each worksheet is discussed individually in the succeeding pages and an example of each is included.

The HCM Input Worksheet is the first HCM worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. The worksheet is also produced when BASIC worksheet OUTPUT is selected. This worksheet lists the input conditions used for the capacity analysis, as described below.

Intersection Name. The node number and name of the intersection.

Area Location Type. The location of the intersection within the metropolitan area, either CBD or NONCBD.

Schematic Diagram

Volumes, widths and lanes are shown on a schematic diagram of the intersection, along with certain phasing parameters, as described below. For each traffic movement, the top or left-most entry is the volume, the middle entry is the lane group width and the bottom or right-most entry is the number of lanes.

Volumes. The actual demand volume of vehicles, in vehicles per hour, for each of the twelve movements of the intersection.

Widths. The amount of roadway width, in feet, which has been allocated for each lane group at the intersection.

Lanes. The number of lanes which have been striped for each of the specified lane group widths. Movements which are part of dual-optional lane groups are represented with a plus sign next to the turning lane and a minus sign next to the shared lanes.

Sequence. The phasing sequence code for the phasing of the intersection, using the standard TEAPAC phasing codes described in Chapter 1 of the manual.

Permissive. The permissive flags (NO or YES) indicate if left turns are permitted on a green ball following or preceding an exclusive left turn phase (permitted left condition) for each of the four left turns.

Overlap. The overlap flags (NO or YES) indicate whether right turns are allowed to overlap into adjacent protected left turn phases when exclusive right turn lanes exist, for each of the four right turns.

Leadlag. The leadlag entries identifies whether the phasing for the sequence code appears in its normal order (LEAD or NONE), or is reversed (LAG).

Tabulated Parameters

Additional parameters for the analysis are displayed in tabular format, with each column of the table representing the twelve movements of the intersection (upper portion of table) and the four approaches of the intersection (lower portion of table).

Heavy Vehicles. The percentage of trucks and through buses for each movement.

Peak Hour Factor. The peak hour factor for each movement of the intersection.

Pretimed or Actuated. A P or A indicating whether a movement is Pretimed or part of an Actuated phase module. If all entries are P, every movement is analyzed as a fixed-time lane group. If entries for all non-zero lane groups are A, every movement is analyzed as a full-actuated lane group. Otherwise a semi-actuated analysis is done.

Startup Lost Time. The amount of time at the start of a phase which is effectively lost due to startup delays, for each movement.

Extension of Effective Green. The amount of time at the end of a phase by which vehicles effectively extend the green into the clearance time, for each movement.

Arrival Type. A value from 1 to 6 quantifying the quality of progression of each movement, 6 indicating nearly perfect progression.

Pedestrian Volume. The volume of pedestrians interfering with right turns on each approach, in pedestrians per hour. For certain phasings, this pedestrian volume may also conflict with left turns on the approach opposite to these right turns.

Bicycle Volume. The volume of bicycles interfering with right turns on each approach, in bikes per hour.

Parking Location. The location of parking on each approach, if it exists. If parking exists, the entry is either RIGHT, LEFT or BOTH to indicate which side of the approach the parking is on. If no parking exists, the entry is NONE.

Parking - Maneuvers. The number of parking maneuvers per hour on one side of an approach. If the value in the Parking Location row (see above) is NO, the number of Parking Maneuvers is

ignored, and thus has no impact on any calculations. This is commonly the case when the Parking Maneuvers entry uses the default of 20 maneuvers per hour, but there is no parking, as indicated by a NONE in the Parking Location column.

Bus Stops. The hourly volume of local buses which stop at a bus stop on each approach, in buses per hour.

Grade. The percent grade of each approach, with a negative number representing a down-grade approach.

Phase Sequence

Signal Phasing. The signal phasing that is analyzed is specified with a box for each phase of the signal operation indicating the movements which are allowed during that phase. Movement arrows formed with asterisks indicate the critical movements in the phasing, if specified. North (or the direction assumed by the user to be north) is always up in the diagrams, as indicated by the North arrow at the left. Phases are numbered consecutively starting with one (1) for the first north-south phase. No attempt is made to identify subphases, lead phases, or overlap phases by the phase number. The coded phase sequence number appears at the top of the phase diagram along with specified lead/lag conditions, if any (otherwise ** is shown).

Timings. The signal timings used for the capacity analysis are given in terms of the cycle length (C) in seconds, the green time for each phase (G) in seconds, and the yellow time plus all-red for each phase (Y+R) in seconds. If a phase's green time is controlled by a minimum, this is indicated by the letter M in the lower left corner of the phase.

The following is an example of the HCM Input Worksheet text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

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SIGNAL2000/TEAPAC[Ver 2.71.07] - HCM Input Worksheet

Intersection #   1 - Lincoln & Main                 Area Location Type: NONCBD

             |      |      |      ||     |                   Key:  VOLUMES -- >
             |  175 |  550 |  125 ||     |                         |   WIDTHS
             | 12.0 | 24.0 | 12.0 ||     |                         v      LANES
             |    1 |    2 |    1 ||      --------------------
             |      |      |      ||    \    60   0.0  0                .
-------------    /      |      \         -------------------       /|\
                                       --   425  24.0  2                |
===================                      -------------------          |
      220  12.0  1  /          +        /    65  12.0  1           North
-------------------                      ===================          |
      450  24.0  2  --
-------------------            \      |      /   -------------
      215  12.0  1  \     ||      |      |      |
--------------------      ||  200 |  370 |   65 |     Phasing:  SEQUENCE     44
                    |     || 12.0 | 24.0 |  0.0 |               PERMSV  Y N Y N
                    |     ||    1 |    2 |    0 |               OVERLP  Y Y Y Y
                    |     ||      |      |      |               LEADLAG   LD LD

                         N                E                S                W
                   RT   TH   LT     RT   TH   LT     RT   TH   LT     RT   TH   LT
===============  ==============   ==============   ==============   ==============
Heavy veh, %HV    2.0  2.0  2.0    2.0  2.0  2.0    2.0  2.0  2.0    2.0  2.0  2.0
Pk-hr fact, PHF   .90  .90  .90    .90  .90  .90    .90  .90  .90    .90  .90  .90
Pretimed or Act     P    P    P      P    P    P      P    P    P      P    P    P
Strtup lost, l1   2.0  2.0  2.0    2.0  2.0  2.0    2.0  2.0  2.0    2.0  2.0  2.0
Ext eff grn, e    2.0  2.0  2.0    2.0  2.0  2.0    2.0  2.0  2.0    2.0  2.0  2.0
Arrival typ, AT     3    3    3      3    3    3      3    3    3      3    3    3
---------------  --------------   --------------   --------------   --------------
Ped vol, vped           10                0               10                0
Bike vol, vbic           0                0                0                0
Parking locatns         NO               NO               NO               NO
Park mnvrs, Nm           0                0                0                0
Bus stops, NB            0                0                0                0
Grade, %G               .0               .0               .0               .0
===============  ==============   ==============   ==============   ==============

      -------------------------------------------------------------------------
Sq 44 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |  Phase 6  |
**/** -------------------------------------------------------------------------
      |     +     | + * +     | +         |       ^   |           |           |
  .   |     +     | + * +     | +         |       ****|           |           |
 /|\  |     +>    |<+ * +>    |<+         |      <****|           |           |
  |   |           |   v       |   ^   ++++|           |           |           |
  |   |           |       ^   |****   v   |           |           |           |
North |    <*     |    <+ + +>|           |++++>      |           |           |
  |   |++++ *     |     + + + |           |++++       |           |           |
      |   v *     |     + + + |           |   v       |           |           |
      -------------------------------------------------------------------------
C= 60"| G=    5.5" | G=  14.2" | G=  12.3" | G=  12.0" | G=    0.0" | G=    0.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 0.0" | Y+R= 0.0" |
      -------------------------------------------------------------------------
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SIGNAL2000/TEAPAC - HCM Volume Adjust & Satflow Worksheet

The HCM Volume Adjust & Satflow Worksheet is the second HCM worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. The worksheet is also produced when BASIC worksheet OUTPUT is selected. This worksheet first lists the adjustment to input volumes made for the capacity analysis, then lists the factors and calculations made for the estimated saturation flows, as described below.

Volume Adjustment

Approach and Movement Labels. The one- or two- character approach and movement name designations.

Volume. The actual demand volume of vehicles, in vehicles per hour, for each movement.

Peak Hour Factor. The peak hour factor for each movement.

Adjusted Movement Flow Rate. The rate of vehicular flow, in vehicles per hour, during the peak 15 minute period. Flow rates are calculated by dividing the movement Volumes by the movement Peak Hour Factors above.

Lane Groups. The movements included in each lane group. Lane groups that include a through movement will always be displayed in the through movement column in the table for an approach. Vacant columns indicate that a movement is not itself a lane group but is part of another lane group, if it exists at all.

Adjusted Lane Group Flow. The rate of vehicular flow, in vehicles per hour, that is included in the lane group. This combines all the flow rates for the movements included in the designated lane group.

Proportion of Left Turns. The decimal percentage of left turns in the lane group. If the lane group consists of an exclusive left turn lane, the Proportion of Left Turns will be 1.00 (100%). If the lane group consists of an exclusive right turn lane, the Proportion of Left Turns will be 0.00.

Proportion of Right Turns. The decimal percentage of right turns in the lane group. If the lane group consists of an exclusive right turn lane, the Proportion of Right Turns will be 1.00 (100%). If the lane group consists of an exclusive left turn lane, the Proportion of Right Turns will be 0.00.

Saturation Flow Rate

Approach and Movement Labels. The one- or two- character approach and movement name designations.

Base Saturation Flow. The base (ideal) saturation flow rate per lane for each lane group in passenger cars per hour of green per lane (pcphgpl).

Number of Lanes. The number of lanes in each lane group.

Lane Width Factor. The adjustment factor for lane width determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*. Extrapolation is allowed, with warning messages to the user.

Heavy Vehicle Factor. The adjustment factors for heavy vehicles determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

Grade Factor. The adjustment factors for grades determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

Parking Factor. The adjustment factors for parking determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

Bus Blockage Factor. The adjustment factors for bus blockage determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

Area Type Factor. The adjustment factors for area location type determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

Lane Utilization Factor. The adjustment factors for how balanced each of the individual lanes in a lane group are utilized determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

Left Turn Factor. The adjustment factors for left turns determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*. See the Supplemental LT-Factor Worksheet section for a discussion of how left turn factors are calculated when a permitted left turn phase is present. When a protected-permitted left turn is present, this line of the table lists the satflow adjustment factor for the permitted phase, while additional lines below show the left turn factor and resultant satflow calculated for the protected phase.

Right Turn Factor. The adjustment factors for right turns determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

Ped-Bike Left Turn Factor. The adjustment factors for the effect of pedestrians on left turns determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*. See the Ped-Bike LT Effects Worksheet section for a discussion of how ped-bike left turn factors are calculated when pedestrian interference is present for left turns.

Ped-Bike Right Turn Factor. The adjustment factors for the effect of pedestrians and bicycles on right turns determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*. See the

Ped-Bike RT Effects Worksheet section for a discussion of how ped-bike right turn factors are calculated when pedestrian and/or bicycle interference is present for right turns.

Local Adjustment Factor. A user-defined adjustment factor used like the other saturation flow rate factors to adjust the base saturation flow rate by multiplication, normally used to calibrate the HCM satflow estimate to measured local conditions.

Adjusted Saturation Flow. The resultant saturation flow adjusted for all of the factors described above, in vehicle per hour of green.

Protected Left Turn Factor. When a protected-permitted left turn is present, this line of the table lists the left turn adjustment factors for the protected phase determined from Exhibit 16-7 of the 2000 *Highway Capacity Manual*.

Protected Left Turn Saturation Flow. When a protected-permitted left turn is present, this line of the table lists the resultant saturation flow for the protected left turn phase adjusted for all of the factors described above, in vehicle per hour of green.

The following is an example of the HCM Volume Adjust & Satflow Worksheet text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

SIGNAL2000/TEAPAC[Ver 2.71.07] - HCM Volume Adjust & Satflow Worksheet

Volume Adjustment	N RT	N TH	N LT	E RT	E TH	E LT	S RT	S TH	S LT	W RT	W TH	W LT
Volume, V	175	550	125	60	425	65	65	370	200	215	450	220
Pk-hr fact, PHF	.90	.90	.90	.90	.90	.90	.90	.90	.90	.90	.90	.90
Adj mv flow, vp	194	611	139	67	472	72	72	411	222	239	500	244
Lane group, LG	RT	TH	LT		RT+TH	LT		RT+TH	LT	RT	TH	LT
Adj LG flow, v	194	611	139		539	72		483	222	239	500	244
Prop LT, PLT	.000	.000	1.00		.000	1.00		.000	1.00	.000	.000	1.00
Prop RT, PRT	1.000	.000	.000		.124	.000		.149	.000	1.000	.000	.000

Saturation Flow Rate	N RT	N TH	N LT	E RT	E TH	E LT	S RT	S TH	S LT	W RT	W TH	W LT
Base satflo, so	1900	1900	1900		1900	1900		1900	1900	1900	1900	1900
Number lanes, N	1	2	1		2	1		2	1	1	2	1
Lane width, fW	1.000	1.00	1.00		1.000	1.00		1.000	1.00	1.000	1.00	1.00
Heavy veh, fHV	.980	.980	.980		.980	.980		.980	.980	.980	.980	.980
Grade, fg	1.000	1.00	1.00		1.000	1.00		1.000	1.00	1.000	1.00	1.00
Parking, fp	1.000	1.00	1.00		1.000	1.00		1.000	1.00	1.000	1.00	1.00
Bus block, fbb	1.000	1.00	1.00		1.000	1.00		1.000	1.00	1.000	1.00	1.00
Area type, fa	1.000	1.00	1.00		1.000	1.00		1.000	1.00	1.000	1.00	1.00
Lane util, fLU	1.000	.950	1.00		.950	1.00		.950	1.00	1.000	.950	1.00
Left-turn, fLT	1.000	1.00	.279		1.000	.950		1.000	.220	1.000	1.00	.950
Right-turn, fRT	.850	1.00	1.00		.981	1.00		.978	1.00	.850	1.00	1.00
PedBike LT,fLpb	1.000	1.00	.999		1.000	1.00		1.000	.999	1.000	1.00	1.00
PedBike RT,fRpb	.994	1.00	1.00		1.000	1.00		.998	1.00	1.000	1.00	1.00
Local adjustmnt	1.000	1.00	1.00		1.000	1.00		1.000	1.00	1.000	1.00	1.00
Adj satflow, s	1574	3539	519		3473	1770		3454	409	1583	3539	1770
Prot LT fLT	.000	.000	.950					.000	.950			
Prot LT Satflo	0	0	1768					0	1768			

SIGNAL2000/TEAPAC - HCM Supplemental LT-Factor Worksheet

The HCM Supplemental LT-Factor Worksheet is the third HCM worksheet produced the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and calculations made for the permissive left turns in the capacity analysis, as described below. This worksheet is produced only when at least one approach contains a permitted left turn phase.

The one- or two-character approach and movement name designations for each of the left turns at the intersection appear at the top of the worksheet. The worksheet is divided into two sections, the first section listing the input variables used and the second section listing the calculations. The format of the worksheet is a combination of the worksheets of Exhibits C16-9 and C16-10 in the 2000 *Highway Capacity Manual* so that all four left turns can be included on a single page, regardless of which worksheet is used. This combined worksheet indicates those entries which are specific to the C16-9 multilane worksheet with the notation (multi) and those which are specific to the C16-10 single-lane worksheet with the notation (1lane).

The input variables include Cycle Length, Actual Green Time, Effective Permitted Green Time, Opposing Effective Green Time, Number of Lanes, Number of Opposing Lanes for Exhibit C16-9 only, Adjusted LT Flow Rate, Proportion of LT in Lane Group, Proportion of Opposing LT for Exhibit C16-10 only, Adjusted Opposing Flow Rate, and Normal Movement Lost Time.

The calculations include Left Turns per Cycle, Opposing Lane Utilization, Opposing Flow per Lane per Cycle, Opposing Platoon Ratio, First LT Effective Green, Opposing Queue Ratio, Opposing Queue Effective Green, Unsaturated Effective Green, Maximum Opposing Vehicles, Proportion TH in Opposing, TH Equivalent for LT, Proportion of LT, Opposing TH Equivalent, Minimum Value for fLT, LT Factor for LT, Unusable gq, and LT Factor for Lane Group.

The following is an example of the HCM Supplemental LT-Factor Worksheet text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

SIGNAL2000/TEAPAC[Ver 2.81] - HCM Supplemental LT-Factor Worksheet

Input/Calculation	N	E	S	W
Cycle length, C	60		60	
Actual green time for LT, G	23.7		23.7	
Effective perm green time, g	18.2		18.2	
Opp. effective green time, go	14.2		14.2	
Number of Lanes, N	1		1	
Number opp. lanes, No (multi)	2		2	
Adjusted LT flow rate, vLT	139		222	
Proportion of LT in LG, PLT	1.000		1.000	
Prop. of opp. LT (1lane), PLTo	.000		.000	
Adjusted opp. flow rate, vo	483		611	
Normal movement lost time, tL	4.0		4.0	
Left turns per cycle, LTC	2.317		3.700	
Opp. Lane Utilization, fLUo	.950		.950	
Opp. flow /lane /cycle, Volc	4.237		5.360	
Opposing platoon ratio, Rpo	1.000		1.000	
First LT effect. green, gf	.000		.000	
Opposing queue ratio, qro	.763		.763	
Opp. queue effect. green, gq	7.534		9.964	
Unsaturated effect. green, gu	10.657		8.226	
Max. opp. vehicles, n (1lane)	3.767		4.982	
Prop. TH in opp., PTHo (1lane)	1.000		1.000	
TH equivalent for LT, EL1	2.099		2.378	
Proportion of LT, PL (multi)	1.000		1.000	
Opp. TH equiv., EL2 (1lane)	1.000		1.000	
Minimum value for fLT, fmin	.220		.220	
LT factor for LT, fm (multi)	.279		.220	
Unusable gq, gdiff (1lane)	7.534		9.964	
LT factor for lane group, fLT	.279		.220	

SIGNAL2000/TEAPAC - HCM Ped-Bike LT Effects Worksheet

The HCM Ped-Bike LT Effects Worksheet is the fourth HCM worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and calculations made for the effect of pedestrians and bicycles on saturation flows involving left turns, as described below.

Effective ped green time. The effective green time, in seconds, used by the pedestrians.

Conflicting ped volume. The volume of pedestrians across the intersection leg that conflicts with the left turns, in peds per hour.

Ped flow rate. The rate of flow of pedestrians during the effective green period, in peds per hour.

Avg. ped occupancy. The average pedestrian occupancy based on the ped flow rate.

Opposing queue clear time. The time in seconds it takes the opposing queue to clear from its queued state, in seconds.

Opposing queue g ratio. The proportion of the effective ped green time consumed by the opposing queue clear time.

Ped occupancy after queue. Pedestrian occupancy after the opposing queue clears.

Opposing flow rate. Flow rat eof opposing traffic, in vehicles per hour.

Relevant occupancy. The relevant occupancy based on pedestrian occupancy and gap availability.

 # receiving lanes. The number of receiving lanes for the left turn movement.

 # turning lanes. The number of turning lanes for the left turn movement.

Adjustment factor. The permitted phase pedestrian/bicycle adjustment factor.

Proportion left turns. The proportion of left turns in the lane group.

Prop LT in prot phase. The proportion of left turns using the protected phase.

Ped-bike adjust factor. The resultant pedestrian/bicycle satflow adjustment factor.

The following is an example of the HCM Ped-Bike LT Effects Worksheet text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report

contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

SIGNAL2000/TEAPAC[Ver 2.71.07] - HCM Ped-Bike LT Effects Worksheet

Input/Calculation	N	E	S	W
Effective ped green time, gp	14.2	12.0	14.2	12.0
Conflicting ped volume, Vped	10	0	10	0
Ped flow rate, Vpedg	42.282	.000	42.282	.000
Avg. ped occupancy, OCCpedg	.021	.000	.021	.000
Opposing queue clear time, gq	7.534	.000	9.964	.000
Opposing queue g ratio, gq/gp	.531	.000	.702	.000
Ped occ after queue, OCCpedu	.016	.000	.014	.000
Opposing flow rate, Vo	483	0	611	0
Relevant occupancy, OCCr	.008	.000	.006	.000
# receiving lanes, Nrec	2	2	2	2
# turning lanes, Nturn	1	1	1	1
Adjustment factor, ApbT	.995	1.000	.996	1.000
Proportion left turns, PLT	1.000	1.000	1.000	1.000
Prop LT in prot phase, PLTA	.759	1.000	.821	1.000
Ped-bike adjust factor, fLpb	.999	1.000	.999	1.000

SIGNAL2000/TEAPAC - HCM Ped-Bike RT Effects Worksheet

The HCM Ped-Bike RT Effects Worksheet is the fifth HCM worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and calculations made for the effect of pedestrians and bicycles on saturation flows involving right turns, as described below.

Effective ped green time. The effective green time, in seconds, used by the pedestrians.

Conflicting ped volume. The volume of pedestrians across the intersection leg that conflicts with the right turns, in peds per hour.

Conflicting bike volume. The volume of bicycles across the intersection leg that conflicts with the right turns, in bikes per hour.

Ped flow rate. The rate of flow of pedestrians during the effective green period, in peds per hour.

Avg. ped occupancy. The average pedestrian occupancy based on the ped flow rate.

Effective bike green time. The effective green time, in seconds, used by the bicycles.

Bike flow rate. The rate of flow of bicycles during the effective green period, in bikes per hour.

Avg. bike occupancy. The average bicycle occupancy based on the bike flow rate.

Relevant occupancy. The relevant occupancy based on pedestrian occupancy and bicycle conflict zone occupancy.

 # receiving lanes. The number of receiving lanes for the right turn movement.

 # turning lanes. The number of turning lanes for the right turn movement.

Adjustment factor. The permitted phase pedestrian/bicycle adjustment factor.

Proportion right turns. The proportion of right turns in the lane group.

Prop RT in prot phase. The proportion of right turns using the protected phase.

Ped-bike adjust factor. The resultant pedestrian/bicycle satflow adjustment factor.

The following is an example of the HCM Ped-Bike RT Effects Worksheet text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

SIGNAL2000/TEAPAC[Ver 2.71.07] - HCM Ped-Bike RT Effects Worksheet

Input/Calculation	N	E	S	W
Effective ped green time, gp	14.2	12.0	14.2	12.0
Conflicting ped volume, Vped	10	0	10	0
Conflicting bike volume, Vbic	0	0	0	0
Ped flow rate, Vpedg	42.282	.000	42.282	.000
Avg ped occupancy, OCCpedg	.021	.000	.021	.000
Effective bike green time, g	14.2	12.0	14.2	12.0
Bike flow rate, Vbicg	.000	.000	.000	.000
Avg bike occupancy, OCCbicg	.000	.000	.000	.000
Relevant occupancy, OCCr	.021	.000	.021	.000
# receiving lanes, Nrec	2	2	2	2
# turning lanes, Nturn	1	1	1	1
Adjustment factor, ApbT	.987	1.000	.987	1.000
Proportion right turns, PR	1.000	.124	.149	1.000
Prop RT in prot phase, PRA	.534	.000	.000	.443
Ped-bike adjust factor, fRpb	.994	1.000	.998	1.000

SIGNAL2000/TEAPAC - HCM Capacity and LOS Worksheet

The HCM Capacity and LOS Worksheet is the sixth HCM worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. The worksheet is also produced when BASIC worksheet OUTPUT is selected. This worksheet first lists the calculations of capacities and v/c's made for the capacity analysis, then lists the calculations of delay and level of service made for the capacity analysis, as described below.

Capacity Analysis

Approach and Movement Labels. The one- or two- character approach and movement name designations.

Lane Group. The movements included in each lane group. Lane groups that include a through movement will always be displayed in the through movement column in the table.

Adjusted Flow. The adjusted flow rate, in vehicles per hour, for each lane group.

Saturation Flow. The adjusted saturation flow, in vehicle per hour of green, for each lane group.

Lost Time. The lost time, in seconds, for each lane group.

Effective Green. The effective green time, in seconds, for each lane group.

Green Ratio. The g/C ratios for each lane group.

Lane Group Capacity. The lane group capacity, in vehicles per hour, for each lane group.

Volume/Capacity Ratio. The volume/capacity ratio for each lane group.

Flow Ratio. The ratio of the Adjusted Flow to the Saturation Flow for each lane group.

Critical Lane Groups. The lane groups that are on the critical path as defined by the 2000 *Highway Capacity Manual* are flagged in this row with an asterisk.

Permitted Phases of Compound Left Turns. When a left turn is only protected or only permitted, only a single line appears in the worksheet, as described above. When a compound left turn phasing exists (protected-permitted or permitted-protected), the protected phase for the left turn is detailed in the section described above, then each of the same variables are described in a second section for the permitted phases. The totals for the combined phases appear in the Delay and LOS section which follows.

Sum of the Critical Flow Ratios. The sum of the Flow Ratios (v/s) for the Critical Lane Groups.

Total Lost Time Per Cycle. The time, in seconds, during which the intersection is not used effectively by any movement.

Critical v/c Ratio. This is calculated according to the formula for Xc in the 2000 *Highway Capacity Manual*.

Delay and LOS

Approach and Movement Labels. The one- or two- character approach and movement name designations.

Adjusted Flow. The adjusted flow rate, in vehicles per hour, for each lane group.

Lane Group Capacity. The lane group capacity, in vehicles per hour, for each lane group.

Volume/Capacity Ratio. The volume/capacity ratio for each lane group.

Green Ratio. The g/C ratio for each lane group. The green ratio for both phases is displayed for protected-permitted left turns.

Uniform Delay (d_1). The uniform delay term, d_1, in seconds per vehicle, as calculated by the 2000 *Highway Capacity Manual* methods.

Incremental Calibration Term. The delay calibration term for the incremental delay calculation for an actuated condition as determined in Exhibit 16-13 of the 2000 *Highway Capacity Manual*.

Incremental Delay (d_2). The incremental delay term, d_2, in seconds per vehicle, as calculated by the 2000 *Highway Capacity Manual* methods.

Queue Delay (d_3). The initial queue delay term, d_3, in seconds per vehicle, as calculated by the 2000 *Highway Capacity Manual* methods.

Uniform Delay (d_1*). The uniform delay term, d_1, in seconds per vehicle, as re-calculated by the 2000 *Highway Capacity Manual* methods for the d_3 delay term.

Progression Factor. The adjustment to be made to the uniform delay calculation for a non-random arrival condition as determined in Exhibit 16-12 of the 2000 *Highway Capacity Manual*.

Control Delay. The control delay for each lane group, as the sum of d_1 adjusted by the Progression Factor plus d_2 plus d_3, in seconds per vehicle.

Lane Group Level of Service. The Level of Service for the lane group as determined from the lane group control delay and Exhibit 16-2 of the 2000 *Highway Capacity Manual*. If the delay value is in the better half of the range of delay allowed for a given level of service, the level of service listed will be accompanied by a plus sign (+) to the right of the LOS letter.

Final queue. The final initial queue (unmet demand) at the end of the analysis period, in vehicles.

Approach Delay. The weighted average of lane group Control Delay for all lane groups on an approach, weighted by the volume in each lane group experiencing each different delay value, in seconds per vehicle.

Approach Level of Service. The level of service for each approach as determined from the Approach Delay and Exhibit 16-2 of the 2000 *Highway Capacity Manual*. If the delay value is in the better half of the range of delay allowed for a given level of service, the level of service listed will be accompanied by a plus sign (+) to the right of the LOS letter.

Approach Flow. The total adjusted flow rate, in vehicles per hour, for all lane groups on each approach.

Intersection Delay. The weighted average of Approach Delay for all approaches at the intersection, in seconds per vehicle.

Intersection Level of Service. The level of service for the intersection as determined from the Intersection Delay and Exhibit 16-2 of the 2000 *Highway Capacity Manual*. If the delay value is in the better half of the range of delay allowed for a given level of service, the level of service listed will be accompanied by a plus sign (+) to the right of the LOS letter.

The following is an example of the HCM Capacity and LOS Worksheet text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - HCM Capacity and LOS Worksheet

Capacity                 N                E                S                W
Analysis            RT   TH   LT     RT   TH   LT     RT   TH   LT     RT   TH   LT
===============  ==============  ==============  ==============  ==============
Lane group, LG      RT   TH   LT      RT+TH   LT      RT+TH   LT     RT   TH   LT
Adj Flow, v        194  611  139        539   72        483  164    239  500  244
Satflow, s        1574 3539 1768       3473 1770       3454 1768   1583 3539 1770
Lost time, tL      4.0  4.0  4.0        4.0  4.0        4.0  4.0    4.0  4.0  4.0
Effect green, g   30.5 14.2  5.5       12.0 12.3       14.2  5.5   21.5 12.0 12.3
Grn ratio, g/C    .508 .237 .092       .200 .204       .237 .092   .359 .200 .204
LG capacity, c     799  837  163        694  362        817  164    568  707  362
v/c ratio, X      .243 .730 .853       .777 .199       .591 1.00   .421 .707 .674
Flow ratio, v/s   .123 .173 .079       .155 .041       .140 .093   .151 .141 .138
Crit lane group          *                *                    *                *
---------------  --------------  --------------  --------------  --------------
Permitted Phases of Compound Left Turns
Adj Flow, v                    0                                  58
Satflow, s                   519                                 409
Lost time, tL                 .0                                  .0
Effect green, g             18.2                                18.2
Grn ratio, g/C              .303                                .303
LG capacity, c               157                                 124
v/c ratio, X                .000                                .468
Flow ratio, v/s             .000                                .142
Crit lane group
---------------  --------------  --------------  --------------  --------------
Sum crit v/s,Yc      0.558       Total lost, L       16.0
Crit v/c, Xc          .762
===============  ==============  ==============  ==============  ==============

Delay                    N                E                S                W
and LOS             RT   TH   LT     RT   TH   LT     RT   TH   LT     RT   TH   LT
===============  ==============  ==============  ==============  ==============
Lane group, LG      RT   TH   LT      RT+TH   LT      RT+TH   LT     RT   TH   LT
Adj Flow, v        194  611  139        539   72        483  222    239  500  244
LG capacity, c     799  837  320        694  362        817  288    568  707  362
v/c ratio, X      .243 .730 .434       .777 .199       .591 .771   .421 .707 .674
Grn ratio, g/C    .508 .237 .396       .200 .204       .237 .396   .359 .200 .204
Unif delay, d1     8.3 21.1 12.5       22.7 19.8       20.3 13.6   14.5 22.4 22.0
Incr calib, k      .50  .50  .50        .50  .50        .50  .50    .50  .50  .50
Incr delay, d2      .7  5.6  4.2        8.3  1.2        3.1 17.9    2.3  5.9  9.6
Queue Delay, d3     .0  3.8   .0         .0   .0        2.6   .0     .0   .0   .0
Unif delay, d1*     .0 21.4   .0         .0   .0       20.6   .0     .0   .0   .0
Prog factor, PF   1.00 1.00 1.00       1.00 1.00       1.00 1.00   1.00 1.00 1.00
Contrl delay, d    9.0 30.8 16.7       31.1 21.0       26.4 31.5   16.8 28.3 31.7
Lane group LOS       A    C    B          C   C+         C+    C      B    C    C
Final Queue,Qbi      0    0    0          0    0          0    0      0    0    0
---------------  --------------  --------------  --------------  --------------
Appr delay, dA       24.3             29.9             28.0             26.3
Approach LOS           C+                C                C               C+
Appr flow, vA         944              611              705              983
---------------  --------------  --------------  --------------  --------------
Intersection:    Delay      26.8  LOS           C+
===============  ==============  ==============  ==============  ==============
```

SIGNAL2000/TEAPAC - HCM Supplemental Uniform Delay Worksheet

The HCM Supplemental Uniform Delay Worksheet is the seventh HCM worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and delay calculations made for the protected-permitted left turns in the capacity analysis, as described below. This worksheet is produced only when at least one approach contains a compound left turn phasing (protected-permitted or permitted-protected).

The one- or two-character approach name designations for each of the left turns at the intersection appear at the top of the worksheet. The worksheet is divided into two sections, the first section listing the input variables used and the second section listing the calculations.

The input variables include Adjusted LT Volume, v/c Ratio, Primary Movement Effective Green, Opposing Queue Effective Green, Unsaturated Effective Green, Red Time, Arrival Rate, Primary Satflow Rate, and Secondary Satflow Rate.

The calculations include Permitted v/c Ratio, Protected v/c Ratio, v/c Case Number, Queue at Beginning Green Arrow, Queue at Beginning Unsaturated Green, Residual Queue, and Uniform Delay.

The following is an example of the HCM Supplemental Uniform Delay Worksheet text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - HCM Supplemental Uniform Delay Worksheet

Input/Calculation                         N          E          S          W
===============================  ==========  ==========  ==========  ==========
Adjusted LT volume, v                   139                     222
v/c ratio, X                           .434                    .771
Primary mov. effect. green, g           5.5                     5.5
Opp. queue effect. green, gq          7.534                   9.964
Unsaturated effect. green, gu        10.657                   8.226
Red time, r                            36.3                    36.3
Arrival rate, qa                       .039                    .062
Primary satflow rate, sp               .491                    .491
Secondary satflow rate, ss             .246                    .251
-------------------------------  ----------  ----------  ----------  ----------
Permitted v/c ratio, Xperm             .268                    .542
Protected v/c ratio, Xprot             .592                    .946
v/c case number, Case                     1                       1
Queue at beg. green arrow, Qa         1.400                   2.236
Queue at beg. unsat. grn., Qu          .291                    .614
Residual queue, Qr                     .000                    .000
Uniform delay, d1                      12.5                    13.6
===============================  ==========  ==========  ==========  ==========
```

SIGNAL2000/TEAPAC - HCM Initial Queue Delay Worksheet

The HCM Initial Queue Delay Worksheet is the eighth HCM worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and delay calculations made for lane groups which have an initial queue at the start of the analysis period. This worksheet is produced only when at least one approach contains a non-zero initial queue.

Duration. The duration of the analysis period, in hours.

Cycle. The cycle length, in seconds.

Approach and Movement Labels. The one- or two- character approach and movement name designations.

Lane group. The movements included in each lane group.

Initial queue. The initial queue in each lane group at the start of the analysis period, due to unmet demand from the previous analysis period.

Green ratio. The effective g/C ratio for each lane group.

v/c ratio. The volume/capacity ratio for each lane group.

Adjusted capacity. The capacity of each lane group, in vehicles per hour.

Duration unmet. The duration of unmet demand during the analysis period, in hours, for each lane group.

Case number. The case number for the determination of d_3 for each lane group.

Delay parameter. The delay parameter, u, for the determination of d_3 for each lane group.

Queue delay. The initial queue delay, d_3, in seconds, for each lane group.

Uniform delay. The adjusted calculation of uniform delay, d_1, in seconds, for each lane group.

Last departure. The time of the last departure of vehicles which entered the intersection during the analysis period, in hours, measured from the start of the analysis period (the supplemental clearing time).

Final queue. The final initial queue (unmet demand) at the end of the analysis period, in vehicles.

The following is an example of the HCM Initial Queue Delay Worksheet text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - HCM Initial Queue Delay Worksheet

Durat, T 0.25 h          N                E                S                W
Cycle, C   60 s    RT   TH   LT     RT   TH   LT     RT   TH   LT     RT   TH   LT
===============   ==============   ==============   ==============   ==============
Lane group, LG     RT   TH   LT        RT+TH  LT        RT+TH  LT     RT   TH   LT
Init queue, Qb      0   10    0            0    0          10    0      0    0    0
Grn ratio, g/C   .508 .237 .092         .200 .204        .237 .092   .359 .200 .204
v/c ratio, X      .24  .73  .43          .78  .20         .59  .77    .42  .71  .67
Adj capacity, c   799  837  320          694  362         817  288    568  707  362
Durtn unmet, t    .00  .04  .00          .00  .00         .03  .00    .00  .00  .00
Case number, i      1    3    1            1    1           3    1      1    1    1
---------------   --------------   --------------   --------------   --------------
Delay param, u    .00  .00  .00          .00  .00         .00  .00    .00  .00  .00
Queue delay, d3    .0  3.8   .0           .0   .0         2.6   .0     .0   .0   .0
Unif delay, d1*    .0 21.4   .0           .0   .0        20.6   .0     .0   .0   .0
Last depart, Tc   .00  .25  .00          .00  .00         .25  .00    .00  .00  .00
Final queue,Qbi     0    0    0            0    0           0    0      0    0    0
===============   ==============   ==============   ==============   ==============
```

SIGNAL2000/TEAPAC - HCM Back of Queue Worksheet

The HCM Back of Queue Worksheet is the ninth HCM worksheet produced by the ANALYZE, EVALUATE or QUEUECALCS commands when FULL worksheet OUTPUT is selected. This worksheet lists the factors and queue calculations made for all lane groups in the capacity analysis, as described below. This worksheet is produced only when the selected queue model is one of the HCM queue models, as defined by the first QUEUEMODELS entry.

Queues in worst/average lanes. The HCM queue model can be evaluated for either the average lane in a lane group or the worst lane in a lane group. This is selected by the queue model number of the QUEUEMODELS input. Models 1 & 4 are for the worst lane; models 2 & 5 are for the average lanes. See Appendix C for more on this subject.

Lane group. The movements included in each lane group.

Initial queue. The initial queue in each lane group at the start of the analysis period, due to unmet demand from the previous analysis period.

Lane flow. The total adjusted flow rate per lane, in vehicles per hour per lane, for all lane groups on each approach. This value includes the contribution of initial queue. If a worst-lane analysis has been requested, this value also includes the effect of lane utilization.

Lane satflow. The adjusted saturation flow per lane, in vehicle per hour of green per lane, for each lane group.

Lane capacity. The capacity of each lane of each lane group, in vehicles per hour per lane.

Flow ratio. The ratio of the lane flow to the lane satflow for each lane group.

v/c ratio. The ratio of the lane flow to the lane capacity for each lane group.

Effective green. The effective green time, in seconds, for each lane group.

Green ratio. The effective g/C ratio for each lane group.

Upstream filter. The upstream filtering factor for each lane group.

Green arrivals. The proportion of vehicles arriving on green for each lane group.

Platoon ratio. The platoon ratio for green arrivals in eahc lane group.

Progression factor. The effects of the progression adjustment factor on queueing in each lane group.

Queue (1st term) . The first term of the queued vehicles computation.

Queue factor. The second term adjustment factor.

Queue (2nd term). The second term of the queued vehicles computation.

Avg queue. The average number of queued vehicles in each lane group.

XX% factor. The percentile back of queue factor for the lane group at the percentile level shown.

XX% queue. The percentile back of queue for the lane group at the percentile level shown.

Avg spacing. The average queue spacing between front bumpers of queued vehicles, in feet.

Avail storage. The available queue storage for queued vehicles in each lane group, in feet.

Avg distance. The average distance occupied by queued vehicles in each lane group, in feet.

Avg ratio. The average queue storage ratio (average distance / available storage) for each lane group.

XX% distance. The percentile distance occupied by queued vehicles in each lane group, in feet, for the percentile level shown.

XX% ratio. The percentile queue storage ratio (percentile distance / available storage) for each lane group, for the percentile level shown.

The following is an example of the HCM Back of Queue Worksheet text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

SIGNAL2000/TEAPAC[Ver 2.71.07] - HCM Back of Queue Worksheet

Queues in		N			E			S			W	
Worst Lanes	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
Lane group, LG	RT	TH	LT		RT+TH	LT		RT+TH	LT	RT	TH	LT
Init queue, QbL	0	5	0		0	0		5	0	0	0	0
Ln flow, vL	194	343	139		284	72		275	222	239	263	244
Ln satflow, sL	1574	1863	809		1828	1770		1818	728	1583	1863	1770
Ln capacity, cL	799	441	320		365	362		430	288	568	372	362
Flow ratio, yL	.123	.184	.172		.155	.041		.151	.305	.151	.141	.138
v/c ratio, XL	.243	.778	.434		.777	.199		.640	.771	.421	.707	.674
Effect green, g	30.5	14.2	23.7		12.0	12.3		14.2	23.7	21.5	12.0	12.3
Grn ratio, g/C	.508	.237	.396		.200	.204		.237	.396	.359	.200	.204
Upstr filter, I	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00
Grn arrivals, P	.51	.24	.40		.20	.20		.24	.40	.36	.20	.20
Platn ratio, Rp	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00
Prog factr, PF2	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00
Queue (1st), Q1	1.8	5.3	1.7		4.5	1.0		4.1	3.2	3.0	4.1	3.8
Queue factr, kB	.73	.48	.39		.43	.42		.48	.36	.58	.43	.42
Queue (2nd), Q2	.2	1.9	.3		1.3	.1		1.0	1.1	.4	1.0	.8
Avg queue, Q	2.1	7.3	2.0		5.8	1.1		5.1	4.3	3.4	5.1	4.6
90% factor, fB	1.83	1.62	1.84		1.66	1.90		1.68	1.71	1.75	1.68	1.70
90% queue, Qp	3.8	11.7	3.6		9.6	2.1		8.6	7.3	6.0	8.5	7.8
Avg spacing, Lh	25.3	25.3	25.3		25.3	25.3		25.3	25.3	25.3	25.3	25.3
Avail storg, La	100	1000	250		1000	250		1000	250	100	1000	250
Avg distance	52	184	50		146	28		130	108	87	128	116
Avg ratio, RQ	.52	.18	.20		.15	.11		.13	.43	.87	.13	.46
90% distance	95	297	92		243	53		218	186	152	215	197
90% ratio, RQp	.95	.30	.37		.24	.21		.22	.74	1.52	.22	.79

SIGNAL2000/TEAPAC - Capacity Analysis Summary

The Capacity Analysis Summary report, generated primarily by the ANALYZE command, provides a summary of the capacity analysis for the intersection and all approaches and lane groups of the intersection. This report can also be produced optionally (default) by the DESIGN command. The capacity analysis methodology used for each approach follows the procedures presented in the 2000 *Highway Capacity Manual*. Worksheets presented in the 2000 *Highway Capacity Manual* may be produced optionally by specifying OUTPUT FULL and are discussed previously.

Intersection Averages

Intersection Name. If provided by the user, the node number and name of the intersection appears at the top of the report.

V/C. A measure of the overall performance of the intersection is given by the V/C (degree of saturation). It is computed as the weighted-average V/C of all lane groups weighted by the volume of traffic using each lane group. Degree of saturation for an individual lane group is defined as the volume of traffic using the approach divided by the capacity for that approach in vehicles per hour (v/c). Thus, a degree of saturation of 1.00 on any individual approach indicates that an approach is working exactly at saturation (capacity).

Critical V/C. A measure of the potential performance of the intersection is given by the critical V/C. It is the V/C ratio which can be achieved for the critical movements if the timings are set such that all of the critical movements have the same V/C, as defined by the HCM. It is not, however, necessarily related to the performance of the actual timings, and thus is a measure of the intersection's potential performance, not necessarily its actual performance.

Control Delay. A measure of the average control delay per vehicle in seconds is given for the intersection as a whole. This value is usually much lower than the critical movements of the intersection, who, by definition, have the worst delay values for the intersection.

Level of Service. The level of service of the intersection as a whole. It is based on the average intersection delay described above, according to Exhibit 16-2 of the 2000 *Highway Capacity Manual*. If the delay value is in the better half of the range of delay allowed for a given level of service, the level of service listed will be accompanied by a plus sign (+) to the right of the level.

Signal Phasing and Timing

Signal Phasing. The signal phasing that is analyzed is specified with a box for each phase of the signal operation indicating the movements which are allowed during that phase. Movement arrows formed with asterisks indicate the critical movements in the phasing. North (or the direction assumed by the user to be north) is always up in the diagrams as shown by the North arrow. Phases are numbered consecutively starting with one (1) for the first north-south phase.

No attempt is made to identify subphases, lead phases, or overlap phases by the phase number. The coded phase sequence number appears at the top of the phase diagram.

Timings. The timings used for each phase are given in terms of green time to cycle time ratio (G/C) in seconds per second, green time (G) in seconds, and yellow plus all-red time (Y+R) in seconds. The offset to the beginning of each phase (OFF) is shown in percent of the cycle. The cycle length and total time allocated to green, yellow, and exclusive pedestrian phases are shown in seconds and percent of cycle below the sequence block. If a phase's green time is controlled by a minimum, this is indicated by the letter M in the lower left corner of the phase.

Capacity Analysis Parameters

Output for the remainder of the Capacity Analysis summary is organized by approach. The top line of each approach's results lists the average delay and level of service for the approach as a whole. The following information is provided for each lane group in that approach.

Lane Group. The movements which make up each lane group are specified with a two-letter code. These codes identify the movements as right turns (RT), throughs (TH), and left turns (LT), or as defined by the user.

Widths/Lanes. The width of pavement which is used by the specified traffic stream is given in feet. The number of lanes which are operated within this width follows, separated from the width by a slash (/). Movements which are part of dual-optional lane groups are represented with a plus sign next to the turning lane and a minus sign next to the shared lanes.

g/C Required and Used. The g/C's which are required to maintain the design level of service and those which are used by the specified timings are given in seconds per second. The design level of service is shown in the first column of the Service Rate section (described below). If the Used g/C is less than the Required g/C, the lane group will operate at a level of service less than that desired, and vice versa.

Service Rate. The service flow rates for the design level of service (usually Level of Service C, by default) and for Level of Service E are tabulated in vehicles per hour. These are the maximum volumes which can exist with the specified timings without exceeding the stated level of service. The level of service for each column is listed in the header of the column.

Adjusted Volume. The Adjusted Volumes are tabulated for each lane group. They represent the sum of the volumes for all movements which are in the specified lane group, as adjusted by the peak hour factors.

Volume/Capacity Ratio. This is the ratio of the adjusted flow rate to the capacity of the lane group.

HCM Delay. The estimated control delay per vehicle in seconds, as calculated using the methods of the 2000 *Highway Capacity Manual*.

Level of Service. The level of service (LS) at which each traffic stream is operating, assuming the specified timings, widths, and other capacity parameters, is specified for each traffic stream. If an LS entry has an asterisk (*) to its left, this indicates that this movement was a critical design movement during optimization of the timings. The levels of service described in the 2000 *Highway Capacity Manual* have been further subdivided to provide a more accurate reflection of approach performance. The delay range for each level of service is divided in half to produce two sublevels, the better performing half receiving an additional plus notation next to the base level of service. For example, Level of Service D as defined in the Capacity Manual can take on two possible levels in this analysis: D and D+. The D+ represents the better half of performance of the defined Level D, making it a performance closer to Level of Service C than Level D without the +. The Level of Service listed for each movement, approach and the intersection is determined from the following table, consistent with, but more detailed than, the manual suggests:

Control Delay Per Vehicle (Sec)	Level of Service
0.0 <= d <=10.0	A
10.0 < d <=15.0	B+
15.0 < d <=20.0	B
20.0 < d <=27.5	C+
27.5 < d <=35.0	C
35.0 < d <=45.0	D+
45.0 < d <=55.0	D
55.0 < d <=67.5	E+
67.5 < d <=80.0	E
80.0 < d	F

Queue Model X. The queue value for each lane group is provided according to the selected queue model. The model used is listed in the column heading as a number from 1 to 10 according to the model number which has been selected by the corresponding QUEUEMODELS entry. Each of the 10 possible queue models is documented in detail in Appendix C. The value listed is always the queue distance, in feet, for a single lane in the lane group. The queue model selected will define what queue formulation is used (MBQ or MQL), whether the queue is for the worst or the average lane, and whether the queue is an average or percentile queue. The default queue model is #1 representing the recommended 2000 *Highway Capacity Manual* MBQ model for the 90th percentile queue in the worst lane using input vehicle lengths.

The following is an example of the Capacity Analysis Summary text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum). Worksheets which may be produced when this command is executed with the OUTPUT FULL option appear earlier.

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - Capacity Analysis Summary

Intersection Averages for Int #   1 - Lincoln & Main
      V/C 0.635  (Critical V/C 0.761)  Control Delay  26.7  Level of Service C+

      -------------------------------------------------
Sq 44 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |
**/** -------------------------------------------------
      |     +     | + * +     | +         |       ^   |
  .   |     +     | + * +     | +         |       ****|
 /|\  |     +>    |<+ * +>    |<+         |      <****|
  |   |           |   v       |   ^   ++++|           |
  |   |           |       ^   |****   v   |           |
North |    <*     |    <+ + +>|           |++++>      |
  |   |++++ *     |     + + + |           |++++       |
      |   v *     |     + + + |           |   v       |
      -------------------------------------------------
      | G/C=0.092 | G/C=0.237 | G/C=0.204 | G/C=0.200 |
      | G=   5.5" | G=  14.2" | G=  12.3" | G=  12.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
      | OFF= 0.0% | OFF=15.9% | OFF=46.2% | OFF=73.3% |
      -------------------------------------------------
      C= 60 sec   G= 44.0 sec = 73.3%  Y=16.0 sec = 26.7%  Ped= 0.0 sec =  0.0%

-------------------------------------------------------------------------------
| Lane   |Width/|     g/C     | Service Rate|  Adj |      |  HCM  | L | Queue |
|  Group | Lanes| Reqd   Used | @C (vph) @E |Volume|  v/c | Delay | S |Model 1|
-------------------------------------------------------------------------------

 N Approach                                              24.3   C+
===============================================================================
|   RT   | 12/1 |0.182 |0.508 |  756 |  799 |  194 |0.243 |   9.0 | A |  95 ft|
|   TH   | 24/2 |0.222 |0.237 |  671 |  816 |  611 |0.730 |  30.8 |*C | 297 ft|
|   LT   | 12/1 |0.027 |0.092 |  263 |  320 |  139 |0.434 |  16.7 | B |  92 ft|
-------------------------------------------------------------------------------

 S Approach                                              28.0   C
===============================================================================
|RT+TH   | 24/2 |0.195 |0.237 |  650 |  795 |  483 |0.591 |  26.4 | C+| 218 ft|
|   LT   | 12/1 |0.087 |0.092 |  234 |  288 |  222 |0.771 |  31.5 |*C | 186 ft|
-------------------------------------------------------------------------------

 E Approach                                              29.9   C
===============================================================================
|RT+TH   | 24/2 |0.188 |0.200 |  585 |  694 |  539 |0.777 |  31.1 |*C | 243 ft|
|   LT   | 12/1 |0.090 |0.204 |  268 |  362 |   72 |0.199 |  21.0 | C+|  53 ft|
-------------------------------------------------------------------------------

 W Approach                                              26.3   C+
===============================================================================
|   RT   | 12/1 |0.209 |0.359 |  498 |  568 |  239 |0.421 |  16.8 | B | 152 ft|
|   TH   | 24/2 |0.174 |0.200 |  598 |  707 |  500 |0.707 |  28.3 | C | 215 ft|
|   LT   | 12/1 |0.192 |0.204 |  268 |  362 |  244 |0.674 |  31.7 |*C | 197 ft|
-------------------------------------------------------------------------------
```

SIGNAL2000/TEAPAC - Evaluation of Intersection Performance

The Evaluation of Intersection Performance generated by the EVALUATE command is a report designed to summarize a number of performance measures for each lane group, as well as the roadway conditions and capacities of each group. The emphasis is primarily on the estimated level of each stream's performance, rather than on the parameters which were used to calculate the level, as in the case of the Capacity Analysis Summary. The capacity analysis methodology used for each traffic stream follows the procedures presented in the 2000 *Highway Capacity Manual*. Worksheets presented in the 2000 *Highway Capacity Manual* may be produced optionally by specifying OUTPUT FULL, as described previously.

Each lane group for which performance is calculated is designated by an approach width. When an approach is not available for exclusive use by turning vehicles (width of zero feet for the turning movement), the turning vehicle volume is assumed to turn from the adjacent through lane group. In addition to performance levels for each stream, performance is estimated for each approach leg of the intersection as well as the overall intersection. The specific elements which make up this report are discussed individually below.

Signal Phasing and Timing

Intersection Name. If provided by the user, the node number and name of the intersection appears at the top of the report.

Signal Phasing. The signal phasing is specified with a box for each phase of the signal operation indicating the movements which are allowed during that phase. Movement arrows formed with asterisks indicate the critical movements in the phasing. North (or the direction assumed to be north by the user) is always up in the diagrams, as shown by the North arrow. Phases are numbered consecutively starting with one (1) for the first north-south phase. No attempt is made to identify subphases, lead phases, or overlap phases by the phase number. The coded sequence number appears at the top of the diagram.

Timings. The timings for each phase are given in terms of green time to cycle time ratio (G/C) in seconds per second, green time (G) in seconds, and yellow plus all-red time (Y+R) in seconds. The offset to the beginning of each phase (OFF) is shown in percent of the cycle. The cycle length and total time allocated to green, yellow, and exclusive pedestrian phases are shown in seconds and percent of cycle below the sequence block. If a phase's green time is controlled by a minimum, this is indicated by the letter M in the lower left corner of the phase.

Capacity Analysis Parameters

Capacity Analysis parameters are reported only by movement, except for the demand volume which is also reported by approach and intersection total.

Adjusted Volume. The adjusted volumes in vehicles per hour are listed for each movement, for each approach, and for the entire intersection.

Approach Width and Lanes. The approach width documents the amount of roadway width which has been allocated for each lane group at the intersection. This is followed by a slash (/) and the number of lanes which have been striped for each of the specified approach widths. Movements which are part of dual-optional lane groups are represented with a plus sign next to the turning lane and a minus sign next to the shared lanes.

g/C Required. The green time to cycle time ratio required to pass the demand volume through the approach width at the noted level of service. This value is computed only for each lane group with a designated approach width.

g/C Used. The portion of the cycle which has been allocated to the traffic stream by the specified phasing and timings, in percent of cycle. This number, when compared to the g/C required, indicates whether or not enough cycle time has been allocated to the stream to allow it to work at the design level of service.

Service Volume. The number of vehicles per hour which can be accommodated by the lane group at the noted level of service, given the phasings and timings specified.

Performance Evaluation Parameters

Performance Evaluation parameters are reported separately first by movement and intersection total, then by approach and intersection total.

Service Level. The service level documents the level of service at which each lane group is operating under the specified phasing and timings, according to the delay calculations of the 2000 *Highway Capacity Manual*. The levels of service described in the 2000 *Highway Capacity Manual* have been further subdivided to provide a more accurate reflection of approach performance. The delay range for each level of service is divided in half to produce two sublevels, the better performing half receiving an additional plus notation next to the base level of service. For example, Level of Service D as defined in the Capacity Manual can take on two possible levels in this analysis: D and D+. The D+ represents the better half of performance of the defined Level D, making it a performance closer to Level of Service C than Level D without the +. The Level of Service listed for each movement, approach and the intersection is determined from the following table, consistent with, but more detailed than, the manual suggests. The level described for each approach and the intersection indicate the weighted average of all levels experienced by that group of movements. It is important to note that this level of service is based on 2000 *Highway Capacity Manual* delay calculations not shown in this report, and not on the average delay values shown in this report (see Average Delay discussion below).

Control Delay Per Vehicle (Sec)	Level of Service
0.0 <= d <=10.0	A
10.0 < d <=15.0	B+
15.0 < d <=20.0	B
20.0 < d <=27.5	C+

```
27.5 <  d <=35.0            C
35.0 <  d <=45.0            D+
45.0 <  d <=55.0            D
55.0 <  d <=67.5            E+
67.5 <  d <=80.0            E
80.0 <  d                   F
```

Degree of Saturation. The degree of saturation represents a measure of the Volume/Capacity (v/c) ratio of each lane group, as well as the weighted-v/c's for each approach and the intersection. The degree of saturation is computed as the demand volume divided by the capacity, both described in vehicles per hour. Thus, a degree of saturation for each leg and the intersection are weighted by the volumes of traffic using each lane group.

HCM Delay. For each lane group, each approach, and the total intersection, the average delay is determined in seconds per vehicle. This value estimates the average delay caused by the traffic signal which will be experienced by drivers at the intersection according to the 2000 *Highway Capacity Manual*.

Total Delay. The sum of the average delays described above for each vehicle which drives through the lane group during the analysis period is calculated as the total delay. This cumulative total delay is converted to vehicle-minutes and represents the total amount of wasted time which is spent at the intersection during the analysis period being studied. Auto occupancies can be applied directly to this value to calculate person-minutes of delay.

Number Stopped. The number of vehicles which will be stopped by the signal during the analysis period is calculated. These vehicles are stopped either due to a red indication or a green indication with a queue still dissipating. The number of stopped vehicles can be compared directly to the demand volume during the analysis period to determine the percentage of vehicles which will be stopped (also interpreted as the probability of a vehicle being stopped by the signal).

Fuel Consumption. If the approach speed of lane groups is input with the NETWORK command, an estimate of the total fuel consumption in gallons during the analysis period is calculated for the idling time and accel/decel to and from the approach speed. If link distance is also input, the freeflow consumption on this link is added to this calculation, and flagged with an "L" to the right of the displayed results.

CO Emissions. If the approach speed of lane groups is input with the NETWORK command, an estimate of the total carbon monoxide (CO) emissions in kilograms during the analysis period is calculated for the idling time and accel/decel to and from the approach speed. If link distance is also input, the freeflow emissions on this link is added to this calculation, and flagged with an "L" to the right of the displayed results.

Queue Calculations

Queue calculations are reported separately first by movement and intersection total, then by approach and intersection total.

<u>Queue X</u>. The queue value for each lane group is reported for the user-selected queue model. The model used is listed in the row heading as a number from 1 to 10 according to the model number which has been selected by the corresponding QUEUEMODELS entry. Each of the 10 possible queue models is documented in detail in Appendix C. The first row of queue displayed is the number of queued vehicles in a single lane of the lane group. The second row is the queue distance, in feet, for that lane. The queue model selected will define what queue formulation is used (MBQ or MQL), whether the queue is for the worst or the average lane, and whether the queue is an average or percentile queue. The default queue model is #1 representing the recommended 2000 *Highway Capacity Manual* MBQ model for a specified percentile queue in the worst lane using specified vehicle lengths. The queue values displayed for each approach and for the intersection are the largest per-lane values for each approach and for the entire intersection.

Intermediate Calculations

An additional report is produced when the EVALUATE command is executed and OUTPUT * * YES is selected. It shows several of the intermediate calculations making up the values presented in the Evaluation of Intersection Performance report described in this section.

<u>Saturation Flow</u>. The saturation flow rate, in vehicles per hour.

<u>Idling Delay</u>. The amount of the total Average Delay which is due to idling time at the intersection, in seconds per vehicle.

<u>Fuel Consumption Components</u>. The three fuel consumption components which make up the Fuel Consumption, all in gallons per hour. The Fuel Consumption is the sum of the F fuel (freeflow), I fuel (idling) and A fuel (accel/decel).

<u>CO Emissions Components</u>. The five CO emissions components which make up the CO Emissions, all in grams per hour. The CO Emissions is the sum of the F emissions (freeflow), I emissions (idling), A emissions (acceleration) and D emissions (deceleration), minus the C emissions (cruise).

The following is an example of the Evaluation of Intersection Performance <u>text-only</u> report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - Evaluation of Intersection Performance

Intersection #   1 - Lincoln & Main

      -------------------------------------------------
Sq 44 |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4  |
**/** -------------------------------------------------
      |     +      | + * +      | +          |       ^   |
   .  |     +      | + * +      | +          |      ****|
  /|\ |     +>     |<+ * +>     |<+          |     <****|
   |  |            |   v        |   ^   ++++|           |
   |  |            |       ^    |****   v   |           |
North |    <*      |    <+ + +>|            |++++>      |
   |  |++++ *      |     + + + |            |++++       |
      |   v *      |     + + + |            |   v       |
      -------------------------------------------------
      | G/C=0.092 | G/C=0.237 | G/C=0.204 | G/C=0.200 |
      | G=   5.5" | G=  14.2" | G=  12.3" | G=  12.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
      | OFF= 0.0% | OFF=15.9% | OFF=46.2% | OFF=73.3% |
      -------------------------------------------------
      C= 60 sec   G= 44.0 sec = 73.3%  Y=16.0 sec = 26.7%  Ped= 0.0 sec =  0.0%

MVMT TOTALS     N Approach      E Approach      S Approach      W Approach    Int
Param:Units    RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT  Total
===========   ============== ============== ============== ============== =====
AdjVol: vph   194  611  139    67  472   72    72  411  222   239  500  244  3243
Wid/Ln:ft/#  12/1 24/2 12/1   0/0 24/2 12/1   0/0 24/2 12/1  12/1 24/2 12/1
g/C Rqd@C:%    18   22    3     0   19    9     0   20    9    21   17   19
g/C Used: %    51   24    9     0   20   20     0   24    9    36   20   20
SV @E:  vph   799  816  320     0  694  362     0  795  288   568  707  362  5711
-----------   -------------- -------------- -------------- -------------- -----
Svc Lvl:LOS     A    C    B          C   C+          C+    C     B    C    C    C+
Deg Sat:v/c  0.24 0.73 0.43  0.00 0.78 0.20  0.00 0.59 0.77  0.42 0.71 0.67  0.64
HCM Del:s/v   9.0 30.8 16.7   0.0 31.1 21.0   0.0 26.4 31.5  16.8 28.3 31.7  26.8
Tot Del:min     7   78   10     0   70    6     0   53   29    17   59   32   361
# Stops:veh    27  141   25     0  128   15     0  107   48    45  116   56   708
Fuel:   gal   1.0  4.3  0.8   0.0  3.8  0.5   0.0  3.2  1.5   1.4  3.4  1.7  21.6L
CO Em:   kg   0.8  4.2  0.7   0.0  3.8  0.4   0.0  3.1  1.5   1.3  3.3  1.7  20.8L
-----------   -------------- -------------- -------------- -------------- -----
Queue 1:veh     4   12    4     0   10    2     0    9    7     6    9    8    12
Queue 1: ft    95  297   92     0  243   53     0  218  186   152  215  197   297
===========   ============== ============== ============== ============== =====


SIGNAL2000/TEAPAC[Ver 2.71.07] - Evaluation of Intersection Performance


APPR TOTALS                                                                  Int
Param:Units     N Approach      E Approach      S Approach      W Approach   Total
===========   ============== ============== ============== ============== =====
AdjVol: vph         944            611            705            983       3243
-----------   -------------- -------------- -------------- -------------- -----
Svc Lvl:LOS          C+             C              C              C+         C+
Deg Sat:v/c        0.59           0.71           0.65           0.63       0.64
HCM Del:s/v        24.3           29.9           28.0           26.3       26.8
Tot Del:min          95             76             82            108        361
# Stops:veh         193            143            155            217        708
Fuel:   gal         6.1            4.3            4.7            6.5       21.6L
CO Em:   kg         5.7            4.2            4.6            6.3       20.8L
-----------   -------------- -------------- -------------- -------------- -----
```

Queue 1:veh	12	10	9	9	12
Queue 1: ft	297	243	218	215	297

SIGNAL2000/TEAPAC - Queuemodel Calculations

The Queuemodel Calculations generated by the QUEUECALCS command is a report designed to compute and provide side-by-side comparison of eight different queue models for each lane group, including the queue model documented in the 2000 *Highway Capacity Manual*. The intent of this report is to allow users to compare the new HCM2000 queue model to other queue models which have been used historically in order to gain confidence in its use. Worksheets presented in the 2000 *Highway Capacity Manual* may be produced optionally by specifying OUTPUT FULL, as described previously. The specific elements which make up this report are discussed individually below.

Signal Phasing and Timing

Intersection Name. If provided by the user, the node number and name of the intersection appears at the top of the report.

Signal Phasing. The signal phasing is specified with a box for each phase of the signal operation indicating the movements which are allowed during that phase. Movement arrows formed with asterisks indicate the critical movements in the phasing. North (or the direction assumed to be north by the user) is always up in the diagrams, as shown by the North arrow. Phases are numbered consecutively starting with one (1) for the first north-south phase. No attempt is made to identify subphases, lead phases, or overlap phases by the phase number. The coded sequence number appears at the top of the diagram.

Timings. The timings for each phase are given in terms of green time to cycle time ratio (G/C) in seconds per second, cycle length (C) in seconds, green time (G) in seconds, and yellow plus all-red time (Y+R) in seconds. If a phase's green time is controlled by a minimum, this is indicated by the letter M in the lower left corner of the phase.

Queue Calculations

The first section of the queue calculations gives queue values in terms of the total number of vehicles queued in each lane of each lane group (vehicles per lane). The second section of the queue calculations gives queue values in terms of the total distance occupied by vehicles queued in each lane of each lane group (feet per lane).

In some cases the queue value or distance occupied cannot be computed or cannot be displayed for one of several possible reasons. In these cases, asterisks '*****' are displayed. For example, for grossly oversaturated conditions, the calculated length of a given queue (in feet) may exceed the integer arithmetic used which has a maximum of 32,767 feet (over six miles!). Also, in Models 7 & 8 where the poisson distribution is used, the factorial portion of the formula may exceed the computational limits of the computer when queues approach one mile in length.

The six columns of information at the left of each section identifies the details of the queue models used with the following information:

Model number. The assigned model number used to identify each of the queue models calculated in this report, 1-10. Models 2 and 5 from the original HCM2000 no longer exist.

Model name. The abbreviated model name for each model calculated, as follows. See Appendix C for more details on each of thses models.

HCM	2000 Highway Capacity Manual
ARRB	Australian Road Research Board (SIDRA)
MBQ	Maximum back of queue model
S97E+	SIGNAL97 Evaluate, enhanced
S97A+	SIGNAL97 Analyze, enhanced
S97E	SIGNAL97 Evaluate
S97A	SIGNAL97 Analyze

Model form. The fundamental form of the model, as follows.

B	Maximum back of queue (MBQ), the maximum extent of the end of the queue from the stop line.
L	Maximum queue length (MQL), the maximum number of vehicles in queue at the end of the red time.

Lane of concern. Which lane of a lane group is the lane for which the queue values apply.

W	The worst lane of the lane group due to the effect of unbalanced lane utilization, as defined by the lane utilization factor.
A	The average lane of the lane group, without the effect of unbalanced lane utilization.

Percentile. The percentile value which the queue value represents. For example, if 90% is shown, this means that the queue value listed is likely to be exceeded only 10% of the time, or that the value listed is likely to encompass 90% of the cycles which might be observed. If a 50% value is shown, this is meant to indicate that only the average value is computed and no percentile is determined.

Vehicle lengths. The average queue spacing between front bumpers of queued vehicles used in the model, first for autos, then for heavy vehicles (auto/heavy), in feet.

At the end of each section, the results for the user-preferred model (Selected Model) are re-displayed for easy reference. The selected model is the one which is displayed in other reports of SIGNAL2000. In the second section which shows queue distances, the available storage distance, in feet (as input by the user) is also displayed, along with the ratio of the selected model's distances to this available storage (the Queue Storage Ratio).

The following is an example of the Queuemodel Calculations <u>text-only</u> report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - Queuemodel Calculations

Intersection #   1 - Lincoln & Main

      -------------------------------------------------
Sq 44 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |
**/** -------------------------------------------------
      |     +     | + * +     | +         |       ^   |
  .   |     +     | + * +     | +         |       ****|
 /|\  |     +>    |<+ * +>    |<+         |      <****|
  |   |           |   v       |   ^   ++++|           |
  |   |           |       ^   |****   v   |           |
North |    <*     |    <+ + +>|           |++++>      |
  |   |++++ *     |     + + + |           |++++       |
      |   v *     |     + + + |           |   v       |
      -------------------------------------------------
      | G/C=0.092 | G/C=0.237 | G/C=0.204 | G/C=0.200 |
C= 60"| G=   5.5" | G=  14.2" | G=  12.3" | G=  12.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
      -------------------------------------------------

QUEUES F L  %  Veh     N Approach     E Approach     S Approach     W Approach
Veh/Ln m n tl  Len    RT   TH   LT   RT   TH   LT   RT   TH   LT   RT   TH   LT
=================== ============== ============== ============== ==============
1 HCM  B W 90 25/40    4   12    4    0   10    2    0    9    7    6    9    8
3 ARRB B W 95 25/40    4    9    4    0    9    2    0    7    8    6    8    8
4 HCM  B W 50 25/40    2    7    2    0    6    1    0    5    4    3    5    5
6 MBQ  B A 50 25/40    2    5    2    0    4    1    0    4    3    3    4    4
7 97E+ L A 90 25/40    2    5    2    0    5    1    0    4    3    4    5    5
8 97A+ L A 90 25/40    2    5    2    0    5    1    0    4    3    4    5    5
9  97E L A 90 25/40    3    8    3    0    7    2    0    6    4    5    7    6
10 97A L A 90 25/40    3    8    3    0    7    2    0    6    4    5    7    6
------------------- -------------- -------------- -------------- --------------
Selected Model # 1     4   12    4    0   10    2    0    9    7    6    9    8
=================== ============== ============== ============== ==============

QUEUES F L  %  Veh     N Approach     E Approach     S Approach     W Approach
Ft/Lan m n tl  Len    RT   TH   LT   RT   TH   LT   RT   TH   LT   RT   TH   LT
=================== ============== ============== ============== ==============
1 HCM  B W 90 25/40   95  297   92    0  243   53    0  218  186  152  215  197
3 ARRB B W 95 25/40  101  233   95    0  218   56    0  183  199  162  198  206
4 HCM  B W 50 25/40   52  184   50    0  146   28    0  130  108   87  128  116
6 MBQ  B A 50 25/40   46  119   43    0  108   25    0   90   81   76   98   95
7 97E+ L A 90 25/40   51  127   51    0  127   25    0  101   76  101  127  127
8 97A+ L A 90 25/40   51  127   51    0  127   25    0  101   76  101  127  127
9  97E L A 90 25/40   81  197   71    0  182   48    0  155  113  129  169  164
10 97A L A 90 25/40   81  197   71    0  182   48    0  155  113  129  169  164
------------------- -------------- -------------- -------------- --------------
Selected Model # 1    95  297   92    0  243   53    0  218  186  152  215  197
Available Storage    100 1000  250    0 1000  250    0 1000  250  100 1000  250
Queue Storage Ratio 0.95 0.30 0.37 0.00 0.24 0.21 0.00 0.22 0.74 1.52 0.22 0.79
=================== ============== ============== ============== ==============
```

SIGNAL2000/TEAPAC - Required g/Cs and LT Clearance Cycles

The Required g/Cs report, generated by the GOVERCS command, identifies the green to cycle time ratios which are required by the adjusted demand volumes in each lane group to maintain each level of service of operation for the given phasing, cycle length and timings. Thus, if a given movement were to receive exactly the g/C shown for a level of service, that movement would operate at exactly that level of service (the service flow rate would equal the adjusted demand volume). This is likely to be an iterative process, since the timings assumed are not likely to be the same as the timings required which are thus calculated.

First the assumed sequence of operation (SEQ=) and assumed cycle length (CYC=) are listed. The adjusted volumes (vehicles per hour) and lane group width assignments (feet) used to calculate the g/C requirements are then listed for each movement. The number of lanes in each lane group follows the width, separated with a slash (/). The required g/C value is displayed, in percent, for each lane group. This value represents the g/C requirement for the protected phase for left turns in protected-permitted operation.

In addition, the maximum cycle length which will allow all left turns to clear the intersection using only the terminating clearance interval is calculated, in seconds (LT Cmax). If the operating cycle length is less than or equal to this cycle length, all of the left turn demand will be able to clear the intersection on clearance intervals, with no time specifically allocated to the left turn (sneakers).

The range of level of service included in this report is controlled by the LEVELOFSERVICE command. This report is also an optional output of the DESIGN command, when extra DESIGN output is requested.

The following is an example of the Required g/Cs and LT Clearance Cycles text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - Required g/Cs and LT Clearance Cycles

Intersection #   1 - Lincoln & Main

SEQ= 44    N Approach      E Approach      S Approach      W Approach
CYC= 60   RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT
=======   ==============  ==============  ==============  ==============
Volumes    194  611  139    67  472   72    72  411  222   239  500  244
Wid/Lan   12/1 24/2 12/1   0/0 24/2 12/1   0/0 24/2 12/1  12/1 24/2 12/1
=======   ==============  ==============  ==============  ==============
LOS=C     18.2 22.2  2.7   0.0 18.8  9.0   0.0 19.5  8.7  20.9 17.4 19.2
LT Cmax               52              100              32               30
-------   --------------  --------------  --------------  --------------
LOS=D     14.6 19.3  0.8   0.0 16.1  6.1   0.0 16.4  6.8  17.1 14.8 15.7
LT Cmax               52              100              32               30
-------   --------------  --------------  --------------  --------------
LOS=E     12.8 18.3  0.0   0.0 14.7  5.1   0.0 15.2  5.5  15.3 13.5 14.0
LT Cmax               52              100              32               30
-------   --------------  --------------  --------------  --------------
LOS=S     12.8 18.3  0.0   0.0 14.7  5.1   0.0 15.2  5.5  15.3 13.5 14.0
LT Cmax               52              100              32               30
=======   ==============  ==============  ==============  ==============
```

SIGNAL2000/TEAPAC - Satflow Rates and LT Clearance Cycles

The Satflow Rates report, generated by the SERVICEVOLUMES command, calculates the saturation flow rates in each lane group for each specified cycle length. The saturation flow rates are given in vehicles per hour of green.

First the assumed sequence of operation (SEQ=) and assumed cycle length (CYC=) are listed. The adjusted volumes (vehicles per hour) and lane group width assignments (feet) used to calculate the saturation flow rates are then listed for each movement. The number of lanes in each lane group follows the width, separated with a slash (/). The saturation flow rates are displayed for each lane group. For left turns, saturation flow rates are given for either the Protected Phase, the Permitted Phase, or both, depending on the type of phasing dictated by the SEQUENCES entry.

The maximum cycle length which will allow all left turns to clear the intersection using only the terminating clearance interval is also calculated, in seconds. If the operating cycle length is less than or equal to this cycle length, all of the left turn demand will be able to clear the intersection on clearance intervals, with no time specifically allocated to the left turn (sneakers).

The following is an example of the Satflow Rates and LT Clearance Cycles text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - Satflow Rates and LT Clearance Cycles

Intersection #   1 - Lincoln & Main

SEQ= 44    N Approach      E Approach      S Approach      W Approach
CYC= 60   RT   TH   LT    RT   TH   LT    RT   TH   LT    RT   TH   LT
=======  ==============  ==============  ==============  ==============
Volumes   194  611  139    67  472   72    72  411  222   239  500  244
Wid/Lan  12/1 24/2 12/1   0/0 24/2 12/1   0/0 24/2 12/1  12/1 24/2 12/1
=======  ==============  ==============  ==============  ==============
Protctd  1574 3539 1768     0 3473 1770     0 3454 1768  1583 3539 1770
Permitd            519                0              409              0
LT Cmax             52              100               32             30
=======  ==============  ==============  ==============  ==============
```

SIGNAL2000/TEAPAC - Display of Intersection Parameters

The Display of Intersection Parameters generated by the MAP command, provides a worksheet document which shows the relative positions of the 12 demand volumes on a schematic diagram of the intersection. In addition to the 12 turning movement volumes, the diagram displays the widths of the lane groups and the number of lanes. If movements are part of a dual-optional lane group, the turning lanes show a plus sign (+) and the shared lanes show a minus sign (-). The lower right corner of the display indicates the phase sequence number, whether permissive left turns are allowed after exclusive left turn phases, whether right turns are allowed to overlap into adjacent phases, and if lead or lag phasing is employed for exclusive left turn phases.

The following is an example of the Display of Intersection Parameters text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - Display of Intersection Parameters

Intersection #   1 - Lincoln & Main

             |      |      |      ||     |                    Key:  VOLUMES -- >
             |  175 |  550 |  125 ||     |                          |   WIDTHS
             | 12.0 | 24.0 | 12.0 ||     |                          v      LANES
             |    1 |    2 |    1 ||      -------------------
             |      |      |      ||    \    60   0.0  0                .
-------------    /      |      \          -------------------         /|\
                                     --   425  24.0  2                  |
===================                       -------------------           |
      220  12.0  1  /          +        /    65  12.0  1              North
-------------------                       ===================           |
      450  24.0  2  --
-------------------            \      |      /   -------------
      215  12.0  1  \     ||      |      |      |
--------------------      ||  200 |  370 |   65 |     Phasing:  SEQUENCE      44
                    |     || 12.0 | 24.0 |  0.0 |               PERMSV  Y N Y N
                    |     ||    1 |    2 |    0 |               OVERLP  Y Y Y Y
                    |     ||      |      |      |               LEADLAG   LD LD
```

SIGNAL2000/TEAPAC - Diagram of Signal Phasing

The diagram generated by the DIAGRAMS command provides a graphical representation of a specified phase sequence code number. This diagram is also an integral part of the output for the ANALYZE and EVALUATE commands, and is an optional output of the TIMINGS command. The sequence code which is represented in the diagram is listed at the top of the diagram, followed by the lead-lag conditions for the north-south and east-west phasings, respectively, separated by a slash, (/).

Each phase is designated by a square box with arrows inside indicating the movements which are allowed during that phase. Although a specific set of movements may be implied by a given sequence code, only those movements which have non-zero volumes will be included in the diagram. Movements which have been designated as critical in each phase are so indicated by asterisks in the body of the arrow, rather than a plus sign, (+). Critical movement identification is done automatically by the TIMINGS command or manually by the CRITICAL command. A North arrow clarifies that North is up in the diagram.

The following is an example of the Diagram of Signal Phasing text-only report using the SIGNAL2000 program sample data. The normal full-color graphics version of the report contains the same results formatted with superior layout, fonts and graphics (it is not included here to keep the size of the downloadable program/demo/update/help/pdf files to a minimum).

```
SIGNAL2000/TEAPAC[Ver 2.71.07] - Diagram of Signal Phasing

      -------------------------------------------------
Sq 44 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |
**/** -------------------------------------------------
      |     +     | + * +     | +         |       ^   |
  .   |     +     | + * +     | +         |       ****|
 /|\  |     +>    |<+ * +>    |<+         |      <****|
  |   |           |   v       |   ^   ++++|           |
  |   |           |       ^   |****   v   |           |
North |    <*     |    <+ + +>|           |++++>      |
  |   |++++ *     |     + + + |           |++++       |
      |   v *     |     + + + |           |   v       |
      -------------------------------------------------
```

APPENDIX E

Error Messages and Trouble Spots

Appendix E Topics

This appendix contains a description of each error message which the SIGNAL2000 program is capable of issuing that is specific to the SIGNAL2000 program. Each SIGNAL2000 program error message is discussed as to the potential cause, as well as actions which might be taken to correct the errors. Note also that additional error messages can be generated by the TEAPAC package itself, or by the operating system environment. These error messages are listed separately in Appendices F and G.

In addition to the SIGNAL2000 error messages, discussion of typical problem areas and potential trouble spots is given to further assist in debugging problems with SIGNAL2000, and to help avoid problems in the future.

Appendix E Topics:

SIGNAL2000 Error Messages

The following messages are issued to indicate that the conditions of the program are not as expected. The S2Kxx number that precedes the message in this document is the error number which is displayed at the top of the error message window. The notes that follow the message here indicate where to look for conditions that may have caused the message, and how to correct these conditions. Messages designated as **WARNINGS** may not cause computations to stop, while those designated as **ERRORS** will terminate all computations.

Errors and Warnings:

S2K06: WARNING
S2K07: ERROR
S2K08: ERROR
S2K09: ERROR
S2K10: ERROR
S2K11: ERROR
S2K13: ERROR
S2K14: ERROR
S2K15: ERROR
S2K16: ERROR
S2K17: ERROR
S2K18: ERROR
S2K19: ERROR
S2K20: WARNING
S2K21: WARNING
S2K22: ERROR
S2K23: WARNING
S2K24: ERROR
S2K25: ERROR
S2K26: WARNING
S2K27: WARNING

S2K01: WARNING
xx-xx lane width exceeds upper limit of XX.X feet and will be extrapolated.

This warning indicates that the calculated average lane width in the noted lane group is greater than or equal to the maximum limit displayed. This is the stated upper limit of lane widths allowed by the 2000 *Highway Capacity Manual*, thus the warning indicates that the calculations will continue by extrapolating the 2000 *Highway Capacity Manual* table and the user is aware of this occurrence. The user is also warned to make sure that the lane group width does not include any parking lane width, as was the case required in earlier versions of SIGNAL and SIGNAL85. See also error #S2K19. Action: Verify that the lane group width has been input according to the proper convention of the 2000 *Highway Capacity Manual*, and that extrapolation is truly desired for inputs outside of the accepted 2000 *Highway Capacity Manual* range.

S2K02: WARNING
Right turns in xx through lanes are xxx.x% which may indicate an input error.

This warning indicates that the percentage of right turns in a through lane group has been calculated as exceeding 50%. The program warns the user because it may be more appropriate to analyze the shared lane as an exclusive turn lane group, but the computations continue as specified. Action: Verify that the lane usage has been input properly and that the high turn percentage is appropriate for continued analysis.

S2K03: WARNING
Left turns in xx through lanes are xxx.x% which may indicate an input error.

This warning indicates that the percentage of left turns in a through lane group has been calculated as exceeding 50%. The program warns the user because it may be more appropriate to analyze the shared lane as an exclusive turn lane group, but the computations continue as specified. <u>Action</u>: Verify that the lane usage has been input properly and that the high turn percentage is appropriate for continued analysis.

S2K04: WARNING
The thru equivalent of the xx left turn suggests a Defacto LT Lane analysis.

This warning indicates that the Defacto Left Turn Lane check calculations indicate that the shared through-turn lane probably behaves like an exclusive turn lane, and should be analyzed as such. The program does not make the defacto left turn adjustment automatically, however, allowing the computations to proceed so that the user can compare this analysis with one where the defacto lane adjustment is made manually by the user according to his professional judgment. <u>Action</u>: Verify that the lane usage used is appropriate, and alternatively conduct another analysis assigning the left-hand through lane to exclusive use by left turning vehicles.

S2K06: WARNING
No sequence codes have been successfully DESIGNed, so none can be ANALYZEd.

This warning indicates that an attempt was made via the DESIGN command to ANALYZE sequences following their design, where no successful sequences were DESIGNed. This is requested with the parameter of the DESIGN command. It usually suggests that the list of SEQUENCES allowed for the DESIGN did not include any phasing codes that were determined to be safe by DESIGN. This may be particularly prevalent if only one sequence code is given on SEQUENCES. <u>Action</u>: The typical response is to change the SEQUENCES list to ALL, then re-issue the DESIGN command.

S2K07: ERROR
SEQUENCE xx has not been successfully DESIGNed, so no TIMINGS are available.

This error indicates that the sequence code requested by the TIMINGS command was not found in the list of successful sequences created by a previous DESIGN command. <u>Action</u>: The successful sequences from the DESIGN can be re-listed with the SORT command, or the DESIGN can be re-generated. Make sure that in either case the desired sequence code is successfully DESIGNed, then re-issue the TIMINGS command. If the sequence code is not successful, optimum timings will have to be generated manually. The GOVERCS command may be useful in creating these optimum timings.

S2K08: ERROR
No sequence codes have been DESIGNed, so none can be SORTed.

This error indicates that a SORT command has been issued to list DESIGN results in sorted order, but a DESIGN has not been conducted for the current intersection. If a DESIGN was executed previously and this message appears, it is likely that the INTERSECTION number has changed since the DESIGN, preventing the SORT from being performed. <u>Action</u>: If the current

intersection is the one desired, issue a DESIGN command first, then issue the SORT command. If a previous DESIGN was for an intersection different than the current intersection, use INTERSECTION to select the intersection of the previous DESIGN, then re-issue the SORT command.

S2K09: ERROR
WIDTHS and LANES entries for xx-xx movement do not agree. Check and re-enter.

This error indicates that for the specified lane group, either a non-zero WIDTH has been specified, but the number of LANES is zero, or a non-zero number of LANES has been specified, but the WIDTH is zero. Action: In either case, review the WIDTHS and LANES command values and make sure that every non-zero WIDTH has a corresponding non-zero number of LANES, and vice versa.

S2K10: ERROR
No WIDTH entry exists for VOLUME on xx-xx movement. Check and re-enter.

This error indicates that the specified movement VOLUME does not have a corresponding lane group WIDTH assigned to it. For a through movement VOLUME, this means no through movement WIDTH has been specified. For a turn lane movement VOLUME, this means neither an exclusive turn lane WIDTH nor an adjacent through movement WIDTH has been specified. Action: Review the VOLUMES and WIDTHS and correct the mis-match.

S2K11: ERROR
No VOLUME entry exists for WIDTH on xx-xx movement. Check and re-enter.

This error indicates that the specified lane group WIDTH does not have any corresponding VOLUMES assigned to it. For a through movement lane group WIDTH, this means there is no through VOLUME, nor is there any adjacent turning movement VOLUME that does not have an assigned exclusive turn lane WIDTH. For an exclusive turn lane group WIDTH, this means there is no turning movement VOLUME. Action: Review the WIDTHS and VOLUMES and correct the mis-match.

S2K13: ERROR
GREENS & YELLOWS must add up to demo limit of 60 or 120 seconds. Re-enter.

In a demonstration version of SIGNAL2000, the cycle length, as defined by the sum of the GREENTIMES and YELLOWTIMES commands, must add up only to 60 or 120 seconds. Action: Correct the timings so this is the case, or purchase a full-use license of SIGNAL2000 to eliminate this artificial constraint. This message will not be issued in a full-use licensed version of SIGNAL2000.

S2K14: ERROR
YELLOWTIMES are limited to values of only 3.0 seconds in demo. Re-enter.

In a demonstration version of SIGNAL2000, the YELLOWTIMES can only take on values of 3.0 seconds. Action: Correct the YELLOWTIMES so this is the case, or purchase a full-use license of SIGNAL2000 to eliminate this artificial constraint. This message will not be issued in a full-use licensed version of SIGNAL2000.

S2K15: ERROR
SEQUENCES list may not include code 0 or less when using DESIGN. Re-enter.

This error indicates that the SEQUENCES list contained a sequence code of 0 (or less) when the DESIGN command was issued. The DESIGN command cannot optimize timings for an arbitrary phasing as defined by the PHASEMOVEMENTS when SEQUENCES is 0. The DESIGN is terminated. Action: The 0 must be removed from the SEQUENCES list. If this is the only phasing code in the SEQUENCES list, the phasing cannot be DESIGNed. In this case, either choose a phasing code that is as similar as possible to the actual phasing, then DESIGN and manually adjust the resultant timings for SEQUENCE 0, or use the GOVERCS command to generate the required greentimes for each of the movements, manually generate optimum timings and perform a capacity analysis for the resultant timings for SEQUENCE 0.

S2K16: ERROR
GREENTIME for phase #X is too low. Enter proper value or use 0.01 seconds.

This error indicates that a phase GREENTIME that has been input is too low. For most phases, this means a value of 0.0 seconds has been encountered, usually because a phase greentime has not been entered. Primary phases may not have zero phase times when performing analyses with ANALYZE, EVALUATE, QUEUECALCS, GOVERCS or SERVICEVOLUMES, otherwise division by zero will occur in the analysis. For the special case of overlap phases (the middle phase of a SEQUENCE 5, 6 or 8), phase green times may actually be negative numbers which are as negative as the clearance for the phase is positive. This is because the time of the overlap phase is not a real display time for any specific movement, but simply the amount of time two phases overlap. If the overlap is small, then the green time will appear to be negative. Action: If GREENTIMES have not been entered for one or more phases, enter the GREENTIMES and re-issue the analysis command. If a phase timing must be analyzed for a zero value, enter 0.01 seconds for the phase. This will appear as a zero in all output, but will not cause division by zero. If the phase in question is an overlap phase, make sure that the negative value of the green time entered is no larger than the positive value of the clearance time for that phase.

S2K17: ERROR
Zero or negative FACTOR for xx-xx movement is not allowed. Check & re-enter.

This error indicates that an adjustment factor has been entered either as a zero or negative value. All FACTORS entered for any movements must be positive numbers greater than zero, otherwise invalid calculations will result. Action: Review the FACTORS and correct the invalid entry.

S2K18: ERROR
No phasing has been defined for SEQUENCE 0. Use PHASEMOVEMENTS to define it.

This error indicates that the special SEQUENCES code 0 (or less) has been selected, but no special phasing has been defined with the PHASEMOVEMENTS command. Action: Select a standard SEQUENCES code greater than 0 or use the PHASEMOVEMENTS command to define the movements which move during each phase of the special phasing.

S2K19: ERROR
xx-xx lane width exceeds lower limit of 8.0 feet and cannot be extrapolated.

This error indicates that the calculated average lane width in the noted lane group is less than 8 feet. This is the stated lower limit of lane widths allowed by the 2000 *Highway Capacity Manual*, thus the error indicates that the calculations cannot continue. Action: Verify that the lane group width has been input according to the proper convention of the 2000 *Highway Capacity Manual*. It is unlikely that an analysis of a lane width of less than 8 feet would yield a valid result, but this can be simulated by using a larger lane group width and adjusting the satflow downwards with an appropriate FACTORS entry.

S2K20: WARNING
Verify STARTUPLOST and ENDGAIN values. Cannot convert old LOSTTIME input.

This warning indicates that a LOSTTIME entry has been encountered, normally when a SIGNAL85 or SIGNAL94 data file has been loaded. Due to the new technique used to calculate lost time values in the 1997 & 2000 HCMs using STARTUPLOST and ENDGAIN values, LOSTTIME entries from older versions of the program cannot be converted reliably. In this case, it is the user's responsibility to make sure that appropriate STARTUPLOST and ENDGAIN values are used. Action: If the default LOSTTIME value (3 seconds) was used in SIGNAL85 or SIGNAL94, the default STARTUPLOST and ENDGAIN values (2 seconds) in SIGNAL2000 are probably appropriate and no action is required. Alternatively, STARTUP and ENDGAIN values can be entered (after the old data is loaded) which result in the desired lost time computation for each movement according to the techniques of the 2000 HCM.

S2K21: WARNING
UTILIZATION entries > 1.0 from old data file have been inverted for HCM 2000.

This warning indicates that a UTILIZATION entry has been encountered with a value greater than 1.0, normally when a SIGNAL85 or SIGNAL94 data file has been loaded. Due to the new technique used to define unbalanced lane utilization in the 1997 & 2000 HCMs, these values have been automatically inverted (1/x) to reflect the new definition. This message warns the user of this automatic conversion. Action: If the UTILIZATION values > 1.0 are, in fact, from an old SIGNAL85 or SIGNAL94 file, no action should be required. In any case, the user should simply make sure that this is the case and verify that the inverted results are appropriate.

S2K22: ERROR
Phasing not appropriate for geometry according to HCM requirements.

This error indicates that a SEQUENCE code has been selected which is not allowed by the methods of the 2000 HCM. This is typically when a type 4, 5 or 6 phasing has been selected, but an exclusive left turn lane does not exist for both left turns served by the protected phasing. If SEQUENCE code 0 has been selected, other requirements may also not be met. For example, movements may not start up more than once during the cycle length, negative movement numbers for permitted left turn operation may not be used unless a protected phase has also been defined, and negative movement numbers may only be used for left turns. Action: Check that an exclusive left turn lane exists for every approach served by a SEQUENCE type 4, 5 or 6. For

SEQUENCE code 0, check that all of the detailed phasing requirements for defining phasings with code 0 have been met.

S2K23: WARNING
Input for XXXXXXXX exceeds limits allowed by HCS. Check results carefully.

This warning indicates that an input to SIGNAL2000 which is being EXPORTed to HCS exceeds a limit imposed by HCS. This is a limit that is more extreme than in SIGNAL2000, so the EXPORT process must limit the HCS input in order to avoid an error condition in HCS. As a result, since the inputs to HCS differ from those made to SIGNAL2000, the results obtained from HCS may differ from the SIGNAL2000 result for that reason. The input variable type is noted in the warning in the XXXXXXXX position of the message. Action: Check the input to HCS for the variable described in the message, and recognize any differences in the results that this changed input may cause.

S2K24: ERROR
Lost time for movement XX results in negative or zero effective green.

This error indicates that the combination of GREENTIMES, YELLOWTIMES, STARTUPLOST and ENDGAIN for the listed movement has resulted in an effective green time less than or equal to zero and computations cannot continue. Action: Adjust any or all of the entries mentioned above for the movement listed such that the resulting effective green time, as defined in the HCM, is greater than zero.

S2K25: ERROR
Host program defined by Options-Setup not found. Install or adjust setup.

A check is made before the Auto option of EXPORT is performed to make sure the required host program (HCS+) is present on the system. This error indicates that the designated host program cannot be located, and the Export is aborted. Action: The Options-Setup menu dialog defines the system path where the host HCS+ program is installed. Use this menu dialog to verify that the entry is correct. Optionally use the Browse button to either verify the path/folder named or to find and select the correct folder (select the required executable file). Press the Save button to save the new configuration. The Save button updates the contents of the SIGNAL20.CFG file for the next time SIGNAL2000 is run. If a change is made, a corresponding change will likely be required in the TEAPAC.CFG file -- if needed, make the change using any available text editor such as NotePad.

If the host program has not been installed, install it and verify the corresponding Options-Setup entry. If the program file to be executed is different than the name expected by SIGNAL2000 the executable file name to be used can be added at the end of the path entry.

S2K26: WARNING
Intersection (or Dummy) with stop or yield control defined is being skipped.

This warning indicates that one of the intersection's movements has been defined with GROUPTYPES as being controlled by a sign, either Stop or Yield, or that the intersection is defined as a 'Dummy node' in the INTERSECTION label. In either case, this condition cannot

be analyzed by SIGNAL2000, and the analysis is aborted with this message. This is the desired response if the data is being included in SIGNAL2000 only for later use by PRETRANSYT or PRENETSIM, either of which will handle the sign-control correctly for TRANSYT and CORSIM, respectively. Action: Make sure that the sign-controlled or 'Dummy node' designation is correct. If this is the case, this and other messages can be closed automatically the next time they occur by selecting this option in the Warning box. If not, use GROUPTYPES to correct the lane group control to something other than sign controlled, or INTERSECTION to correct the 'Dummy node' designation.

S2K27: WARNING
This function is not valid when all intersections have been selected.

This warning indicates that all intersections have been selected (by selecting INTERSECTION 0) and an action which is not valid for all intersections has been requested. For example, SORT and TIMINGS are commands which follow DESIGN, but can only be issued when a single intersection is selected. EXPORT is another such command for a single intersection because HCS can only handle a single intersection. DIAGRAMS is another such command. Action: Select the single intersection of concern with INTERSECTION and re-issue the desired action command. If DESIGN is desired for all intersections, use a non-zero parameter with the DESIGN command, since the manually selective functions of SORT and TIMINGS are not valid when all intersections are selected.

SIGNAL2000 Trouble Spots

A number of common problems occur when people are first using SIGNAL2000, or as they begin to attempt more advanced applications. This section provides a limited discussion of these types of problems that have been identified. If other such problems occur, jot them down in this part of the manual, then contact Strong Concepts so that they may be updated in future issues of the manual, and immediate solutions or workarounds can be developed for you. This approach will also allow for future versions of the program to account for these trouble spots to the degree possible.

Lane Group WIDTH Designation

The WIDTHS command is a powerful command that designates both the width of a lane group as well as its lane usage. As such, it can be initially confusing, but ultimately provides a powerful and easy-to-use means of identifying this information in a simple and concise manner. The first thing to recognize is that if a non-zero WIDTH appears in a through lane group position, this WIDTH can be used by any vehicles on the approach. The only limitation is that turning vehicles that have designated exclusive turn lane WIDTH will not use the through lane width unless a dual-optional GROUPTYPES entry is made. Exclusive turn lane WIDTH is designated by putting a non-zero WIDTH in a turn lane group position.

Another way of looking at this is how VOLUMES are assigned to lane group WIDTHS. Through lane VOLUMES can only be assigned to through lane group WIDTHS. Turning VOLUMES will be assigned entirely to exclusive turn lane group WIDTHS, if they exist, otherwise they will be assigned only the adjacent through lane group WIDTH. If a dual-optional turn lane is defined, turning volumes are assigned to both the turn lane and the adjacent lane group.

A common occurrence of this dilemma is on the stem of a T-intersection, where no throughs exist, but all turns are made out of a single lane approach. In this case, the only option is to declare the single lane as a through lane from which all turns will be made. If more than one lane exists, each can be assigned to the appropriate turns as they are used.

Phasing SEQUENCE Designations

Any time a "sequence code" is required by the program, as is the case for the SEQUENCES, ANALYZE, EVALUATE, QUEUECALCS, EXPORT and DIAGRAMS commands, among others, a two-digit number must be entered. The first digit represents the phasing type for the north-south movements, as defined in Figure 1-2 of Chapter 1, while the second digit represents the phasing type for the east-west movements. This is a standard convention used by all TEAPAC programs which require the specification of a signal phasing. It only requires remembering the eight distinct phasing types shown in Figure 1-2, all of which follow a logical progression of phasing treatment for left turns. By learning these eight types, a combination of 64 distinct phasings can be precisely represented with a single two-digit number. This phasing can also be communicated quickly and succinctly to other users.

Note also that the phasings specified by the sequence code can be altered slightly by the addition of permissive left turns as defined by the PERMISSIVES command, by a change in phase order as defined by the LEADLAGS command, and by the addition of overlapping right turns based on the existence of exclusive right turn lanes (OVERLAPS). Also, if SEQUENCE code -1 through -9 is specified, the phasing can be defined arbitrarily by proper use of the PHASEMOVEMENTS command. In the case of these special SEQUENCE codes, the defined phasing can only be analyzed with ANALYZE, EVALUATE or QUEUECALCS, but cannot be DESIGNed or EXPORTed to HCS.

APPENDIX F

TEAPAC System Error Messages

Appendix F Topics

TEAPAC system messages are displayed by all TEAPAC programs whenever an identifiable fault condition is detected. The message may be due to the command itself, to one of its parameters, or as a result of the action taken by the command. When a condition is detected, an error number and message is displayed identifying the type of condition encountered. This appendix discusses the TEAPAC messages and their meanings, followed by a discussion of potential causes and actions which may correct the conditions. Table F-1 summarizes the error numbers which are discussed in this appendix. The remainder of the appendix lists and discusses each of these messages in numerical order.

The messages in this appendix are specifically TEAPAC system messages which can be detected by any TEAPAC program. These are identified by a prefix of "TPC" in the error code. Appendix E lists those errors which are unique to a specific TEAPAC program. These are identified by a different prefix, "XXX", related to the program being run. Appendix G lists those errors which are generated by the operating environment being used, and as such are unique to that operating environment. The form of these error messages is dependent upon the operating environment being used. Messages are either WARNINGS or ERRORS. A WARNING might be advisory only, while ERRORS are usually fatal and terminate the current action.

Once an error message has been displayed and acknowledged, the program will respond with either an opportunity to re-enter a parameter value, or, in the Manual Mode, the possible need to re-enter an entire new command line in order to fix the error. If a new parameter value is all that is needed to correct the problem, the program will prompt for this using the appropriate dialog.

Table F-1
Summary of TEAPAC System Error Messages

Command Entry Errors
- TPC01: ERROR - command is not recognizable
- TPC02: ERROR - abbreviation for more than one command

File Errors
- TPC11: ERROR - file name cannot be located as specified
- TPC12: ERROR - file number is not in the range of 0 to 5
- TPC13: ERROR - file number is not defined by FILES command
- TPC14: ERROR - requested file number is currently in use
- TPC15: ERROR - file access exceeds 6 levels of nesting
- TPC16: WARNING - file name does not exist, create?
- TPC17: ERROR - read/write error at line xxxxx in file x
- TPC18: WARNING - file name already exists, overwrite?
- TPC19: ERROR - failed attempt to read past end of file x
- TPC20: ERROR - path\file name exceeds size limits
- TPC21: WARNING - data written by XXXXX Vv.vv.bb may be lost, overwrite?
- TPC22: WARNING - possible inconsistent usage of advanced data file

Parameter Errors
- TPC31: WARNING - keyword is not recognizable
- TPC32: WARNING - more parameters found than were expected
- TPC33: WARNING - parameter is not a valid numeric entry
- TPC34: WARNING - integer number not in the accepted range
- TPC35: WARNING - decimal number not in the accepted range
- TPC36: WARNING - node number not in NODELIST

Command as Parameter Errors
- TPC41: WARNING - INVALID COMMAND IGNORED
- TPC42: WARNING - too many commands listed on this command
- TPC43: WARNING - AMBIGUOUS ENTRY IGNORED

Demonstration Errors
- TPC44: ERROR - AUTO Export not allowed for demo
- TPC45: ERROR - only one file can be opened at a time for demo
- TPC46: ERROR - use of printer not allowed for demo
- TPC47: ERROR - writing to disk not allowed for demo
- TPC48: ERROR - allowed input range limited for demo
- TPC49: ERROR - default values cannot be changed for demo

Table F-1 (continued)
<u>Summary of TEAPAC System Error Messages</u>

Command Specific Errors
- TPC51: ERROR - GOTO variable does not match current REPEAT
- TPC52: ERROR - ERROR IN PROGRAM SPECIFICATION
- TPC53: ERROR - REPEAT specification is not valid
- TPC54: ERROR - PERIODS allows only 5 distinct time period ranges
- TPC55: ERROR - PERIODS time period 2nd entry occurs before 1st
- TPC56: ERROR - PERIODS time value entered is not a valid time entry
- TPC57: ERROR - PERIODS time periods entered define too many entries
- TPC58: ERROR - PERIODS time periods entered cannot overlap
- TPC59: ERROR - COUNTS (VEHICLE or TRUCK) too many entries
- TPC60: ERROR - COUNTS (VEHICLE or TRUCK) invalid entry
- TPC61: WARNING - INTERSECTION # required before input can be made
- TPC62: WARNING - INTERSECTION # required before data can be listed
- TPC63: ERROR - INTERSECTION # not in NODELIST
- TPC64: WARNING - old UTILIZATION entries must be inverted
- TPC65: WARNING - negative SEQUENCE code needed to use PHASEMOVS
- TPC66: ERROR - CONDITIONS values cannot be entered for demo
- TPC67: ERROR - PATHASSIGNMENT list must start/end with valid node
- TPC68: WARNING - PATHDISTRIBUTION type # required before input can be made
- TPC69: WARNING - PATHDISTRIBUTION type # required before data can be listed

Miscellaneous Errors
- TPC71: ERROR - BUFFER SIZE EXCEEDED...SORT ABORTED
- TPC72: ERROR - SCRATCH FILE LIMITS EXCEEDED...SORT ABORTED
- TPC81: ERROR - higher Usage Level License is needed
- TPC91: ERROR - HELP FILE MUST HAVE STRING COUNT IN LINE 1
- TPC92: ERROR - TOO MANY CHARS REQUIRED FOR COMMAND STRINGS:

Appendix F Topics
<u>Appendix F Introduction</u>

TPC01 - ERROR
This command is not recognizable. Re-enter or type HELP [ALL] for full list.

This error message will be displayed if a command entry cannot be identified as a valid command. This error is generally generated by the misspelling of a command or an invalid command abbreviation in the Manual Mode. TEAPAC programs will accept a wide variety of abbreviations for any one command as long as the characters are unique to one and only one command (see TPC02 below) and the characters appear in the correct order as in the command. For example, VLMS is a valid abbreviation for the VOLUMES command while VMLS would generate a TPC01 error message. Since the command could not be identified, the program does not process any of the parameters entered and requests another entry. <u>Action</u>: Re-enter the

command or a valid command abbreviation along with its appropriate parameters. Use the Help-Commands menu or HELP [ALL] to see all possible commands alphabetically.

TPC02 - ERROR
This is an abbreviation for more than one command. Use more letters.

This error is generated when the program has been unable to identify one and only one command from an abbreviated command in the Manual Mode. An abbreviation could be a single character if it uniquely defines a command; however, if the character or string of characters can be interpreted as more than one command, a TPC02 error message will be displayed. Since the command could not be identified, the program does not process any of the parameters entered and returns to the command level prompt. This error only applies to the Manual Mode. Action: Re-enter the correct command or a valid command abbreviation along with its appropriate parameters. Use the Help-Commands menu or HELP [ALL] to see all possible commands alphabetically.

TPC11 - ERROR
This file name cannot be located as specified. Re-enter a different name.

This error message has been superseded by TPC16 and TPC18.

TPC12 - ERROR
File number xxxxx is not in the range of 0 to 5. All file access is aborted.

TEAPAC programs can access from one to five data files at a given time. These five files are specified by the use of the FILES command. Each file is numbered from one to five in the order they are entered with the FILES command. Commands such as LOAD and SAVE direct the program to these files by giving the <File Number> of the file to be used. This error will occur if the <File Number> parameter value used is not between 1 and 5, inclusive. Other file access commands, such as OUTPUT, use the <File Number> parameter in a similar fashion. Action: Re-specify the command which is referencing an improper <File Number> with the correct <File Number>.

TPC13 - ERROR
File number xxxxx is not defined by the FILES command. File access aborted.

TEAPAC programs can access from one to five data files at a given time. These five files are specified by the use of the FILES command. Each file is numbered from one to five in the order they are entered with the FILES command. Commands such as LOAD and SAVE direct the program to these files by giving the <File Number> of the file to be used. This error will occur if the <File Number> parameter of a command references a position of the FILES command which is not currently defined. This error typically occurs when the FILES command is not used to define a <File Number> before referencing its use in a LOAD or SAVE command. It may also occur if an incorrect <File Number> was specified. Action: First define the <File Name> for the <File Number> being referenced with the FILES command, then re-issue the file access command; or re-issue the file access command with the correct <File Number>.

TPC14 - ERROR
Requested file number xxxxx is currently in use. All file access is aborted.

Each of the five files named on the FILES command can be accessed by several commands; however, if a file is currently being access by one command (such as LOAD), that file can not be accessed by another command (such as another nested LOAD) until the current access is completed. This situation can occur when using a control file where one file's commands access another file's commands through use of nested LOADs. Action: Remove the multiple referencing to a single <File Number>; or restructure the file access so that one access is completed before the next is begun.

TPC15 - ERROR
File access (LOAD/SAVE/etc) exceeds 6 levels of nesting. All access aborted.

File access commands such as LOAD and SAVE can only be nested to a depth of six levels. If more than six levels of file access are generated, this error message will result. This situation can inadvertently develop when a file process is aborted upon execution of the next file access command. Action: Re-issue the file access command which was aborted (this error will clear all file access); or eliminate the situation which requires more than six levels of file access.

TPC16 - WARNING
This file name does not exist. Create a file by this name? ....(No/Yes)

This error message occurs when the requested <File Name> on the FILES command does not exist. Typically, this occurs when the File Switch for a new file was not used and the file cannot be located as specified (see Appendix G - File Specification). For example, if no Switch is designated and the file does not currently exist, then the warning message will be displayed to indicate that the file will need to be created if it has been specified properly. This condition normally occurs if the name of an existing file is misspelled on the FILES command or a request has been made to use a non-existent file. In either case, this message prevents a new file from inadvertently being created if this was not the intention. Action: The program is prompting the user whether the non-existent file should be created as if the /N switch had been used. By responding "Y" to this prompt, the file name used will be created and the error condition is erased. If any other character is pressed, then the file name will not be created and the user should re-specify the correctly spelled file name.

TPC17 - ERROR
Read/write error at line xxxxx in file x. ESCape to abort continued attempts.

This error indicates that the <Record Number> in the file currently being accessed is not readable. This typically occurs when the record of the file has never been defined by a SAVE command or other file creation techniques. It will also occur if an attempt is made to access data past the physical end of the file, especially if the file does not have an end of file terminator. Action: Re-specify the location within the file to be accessed; or first create information in that part of the file before trying to use it. In the case where repeated TPC17 errors occur through an attempt to LOAD non-existent information from a file (normally past the end of the defined file's contents), the ESCape key will abort the LOAD process and return to enter another command. Frequently, this error can be avoided by adding an end of file terminator to the end of the file.

TPC18 - WARNING
This file name already exists. Use it anyway? .....(No/Yes)

This error message occurs when the requested <File Name> on the FILES command already exists, but the File Switch for a new file was used (see Appendix G - File Specification). For example, if the /N Switch is designated and the file currently exists, then the warning message will be displayed to indicate that the file's contents, if any, will be overwritten if the file has been specified properly. This condition normally occurs if the name of a new file is misspelled on the FILES command or the intended new file name has already been used. In either case, this message prevents the existing file from inadvertently being overwritten if this was not the intention. Action: The program is prompting the user whether the existent file should be used anyway, as if the /N switch had not been used. By responding "Y" to this prompt, the file will be used as specified and the error condition is erased. If any other character is pressed, then the file named will not be overwritten and the user should re-specify the correctly spelled or different file name.

TPC19 - ERROR
Failed attempt to read past end of file x at line xxxxx. File access aborted.

This message indicates that an end of file marker was read in a data file during a read operation (typically LOAD). The program will abruptly halt the file access with this message at that point and return to the command input mode. Normally, this situation will not occur, since the program should return from file access via the occurrence of a RETURN command in the data file. Action: Verify that the file access location is correct and that a RETURN command exists at the end of the file's information. Then re-issue the file access command, if appropriate.

TPC20 - ERROR
Invalid path\file. Path exceeds 180 chars or name of file exceeds 70 chars.

This message indicates that an attempt was made to name or open a file whose file path or file name specification exceeded the TEAPAC limits of 180 characters for the file path or 70 characters for the file name. The file path limit includes the drive letter, and the file name limit includes the file extension and any switches used. Action: If the file path is too long, re-locate the file or sub-folder being used to a location where this limit will not be exceeded. Then re-issue the file access command, if appropriate. As an alternate, network drives can frequently be mapped to a new drive name, thereby reducing the file path length considerably by using a drive letter instead. If the file name is too long, re-name the file so that it meets the file name limit. Since SCENARIO Condition files and certain file switch options can add as many as 6 characters to file names designated by users, it is recommended that user file names not exceed a limit of 64 characters to avoid potential problems when these tools are used.

TPC21 - WARNING
Data written by XXXXX Vv.vv.bb may be lost. Overwrite?...(No/Yes)

This message indicates that a save operation has been requested for a file which contains data which was written by a different TEAPAC program, and thus is subject to possible data loss if the save operation is permitted. The authoring program of a file is determined when a file is opened and used, only if it was created by any TEAPAC program with the Version 5 or later

TEAPAC interface. This message may also be issued if an earlier version of the same TEAPAC program being used created the file and that earlier version saved information in a different manner such that data loss may occur. The authoring program's name, version and build numbers are listed in the warning message. Action: The program is prompting the user whether the existing data in the file should be overwritten anyway. By responding "Y" to this prompt, the file will be used as specified, with the possible loss of prior data values. If any other character is pressed, then the file named will not be overwritten and the user should re-specify a different file name, as appropriate, and re-specify the save operation desired.

TPC22 - WARNING
This Save appears inconsistent with prior Advanced file usage. Save anyway?

This message indicates that a save operation has been requested for a file using a normal Windows menu such as File-Save where it appears that such a save might be inconsistent with prior advanced file usage techniques applied to this same file. Primarily this is detected when the most recent file activity was to a different location in the file, or to a different file. In such a case, a normal Windows save function such as File-Save which will go to line 1 of file 1 is anticipated to be an inadvertant save which might not be desired by the user. Action: This condition is merely a warning to prevent a possible overwrite of data in an advanced use file. The program is prompting the user whether the save should be performed, or not, at the user's discretion. If the save is desired, select Yes; if not or there is any uncertainty, select No to abort the save.

TPC31 - WARNING
This keywordis not recognizable. Look at HELP for its allowed values.

This error message indicates that an invalid parameter value was detected. Generally, this indicates that an invalid character string was entered as a parameter value. Action: Re-enter the appropriate parameter value or values to correct the invalid entry; or press the ENTER key to ignore the invalid entry and leave the previous parameter value.

TPC32 - WARNING
More parameters were found than were expected. The extras have been ignored.

This message is displayed when more parameter values are entered for a particular command than the program will accept. This usually indicates a miscount of input; often a parameter value was entered twice. Most commands will re-prompt for a correct parameter list after this error. After this error, any extra entries will be ignored. The parameter list can also be re-typed starting at the position where a duplicate or unwanted entry was typed. Null (*) entries may be used to skip over to that position in the input. All other correct parameter entries for the command are accepted and processed as usual. Action: Re-enter those parameter values necessary to edit the parameter values into the desired set of values. In the Manual Mode, where this error will most likely occur, it is recommended that the DATA or ASK command be used to verify that the final accepted parameter values are those which were desired.

TPC33 - WARNING
This parameter is not a valid numeric entry. Re-enter with a proper number.

This error message indicates that alphabetic or special characters were entered for a parameter which must be a numeric value. Most commands will re-prompt for parameter re-entry after this error. After this error is received, the invalid entries will be ignored. The parameter list can also be re-typed starting at the position where the invalid entry was typed. Null (*) entries may be used to skip over to that position in the input. All other correct parameter entries for the command are accepted and processed. Action: Re-enter those parameter values necessary to edit the parameter values into the desired set of values. In the Manual Mode, it is recommended that the DATA or ASK command be used to verify that the final accepted parameter values are those which were desired.

TPC34 - WARNING
This integer number is not in the accepted range xxxxx to xxxxx. Re-enter it.
This input is not in the accepted range xxxxxxxxxx to xxxxxxxxxx. Re-enter.

When a parameter value is entered which lies outside the allowable range of values, this error message is displayed. If the input entry accepts decimal places, TPC35 is displayed. If input entries are rounded to the nearest integer value, TPC34 is displayed. The appropriate ranges of allowable values shown in the error message are usually constants; however, they may be controlled by other input parameters on other commands. Further information on input limits can be found in Chapter 4 or Appendix B of the program documentation. Most commands will re-prompt for parameter entry after this error. After the error is issued, the invalid entries will be ignored. The parameter list can also be re-typed starting at the position where invalid entry was typed. Null (*) entries may be used to skip over to that position in the input. All other correct parameter entries for the command are accepted and processed as usual. Action: Re-enter those parameter values necessary to edit the parameter values into the desired set of values. In the Manual Mode, it is recommended that the DATA or ASK command be used to verify that the final accepted parameter values are those which were desired.

TPC35 - WARNING
This decimal number is not in the accepted range xxx.xx to xxx.xx. Re-enter.

When a parameter value is entered which lies outside the allowable range of values, this error message is displayed. If the input entry accepts decimal places, TPC35 is displayed. If input entries are rounded to the nearest integer value, TPC34 is displayed. The appropriate ranges of allowable values shown in the error message are usually constants; however, they may be controlled by other input parameters on other commands. Further information on input limits can be found in Chapter 4 or Appendix B of the program documentation. Most commands will re-prompt for parameter entry after this error. After the error is issued, the invalid entries will be ignored. The parameter list can also be re-typed starting at the position where invalid entry was typed. Null (*) entries may be used to skip over to that position in the input. All other correct parameter entries for the command are accepted and processed as usual. Action: Re-enter those parameter values necessary to edit the parameter values into the desired set of values. In the Manual Mode, it is recommended that the DATA or ASK command be used to verify that the final accepted parameter values are those which were desired.

TPC36 - WARNING
Node # xx used in xxxxxxxxxxxxxxxx entry is not in NODELIST.

When a node number is entered which is not included in the NODELIST, certain functions are not likely to perform properly. These include PATHDISTRIBUTION, PATHASSIGNMENT, GENRATION and ASSIGNMENT. Other entries such as NETWORK and MASTERNODE permit the entry of node numbers not included in the current NODELIST/SUBSYSTEM. Action: In the cases where the entered node number is expected to be included in the NODELIST, either add the intersection to the NODELIST, if appropriate, or change the entry so it uses an intersection number already in the NODELIST.

TPC41 - WARNING
INVALID COMMAND IGNORED

This error message indicates that an invalid command used as a parameter value was detected. This most often occurs when an unrecognizable command string is entered for either the HELP, ASK, DATA, SAVE, or RESET commands. These commands will ignore the entire command list when this occurs. Action: Re-issue the command with the correct or properly abbreviated command parameters.

TPC42 - WARNING
There are too many commands listed as parameters for this command. Re-enter.

This message is displayed when too many commands are entered as parameter values for a particular command. This only occurs when using the HELP, ASK, DATA, SAVE, or RESET commands (which use commands as parameters). Typically, this error occurs when using Group Names as parameter values. The total number of commands contained in the list cannot exceed the total number of commands in the program. When this error occurs, the program will prompt the user to re-enter the command with a shorter list. Action: Re-issue the command with the correct list of command parameters, or re-issue the command several times with partial lists to get the desired result.

TPC43 - WARNING
AMBIGUOUS ENTRY IGNORED

This error is identical to TPC41 above, where the command used as a parameter is ambiguous and the parameter is ignored. Action: Same as TPC41 above.

TPC44 - ERROR
This demonstration version does not permit use of the AUTO option of EXPORT.

For a demonstration program, the AUTO option of EXPORT is disabled. Normally, this option allows the exported file to be launched directly into the host program without the need to name the file and manually run the host program and open the exported file. Action: Purchase a full-use license for this program to enable this feature.

TPC45 - ERROR
This demonstration version permits use of only one file. Others are ignored.

For a demonstration program, the use of multiple files simultaneously is disabled. Normally, this option allows up to five data files to be open simultaneously for easy access to data in all files using the advanced file handling techniques of TEAPAC. Action: Purchase a full-use license for this program to enable this feature.

TPC46 - ERROR
This demonstration version does not permit use of printer. Request ignored.

For a demonstration program, the ability to print results is disabled. Normally, this option allows the contents of any output window to be directed to any printer accessible from your computer. Action: Purchase a full-use license for this program to enable this feature.

TPC47 - ERROR
This demonstration version does not permit use of the AUTO option of EXPORT.

For a demonstration program, writing information to a disk file is disabled. Normally, input data and results can be saved to disk files at locations accessible from your computer. Action: Purchase a full-use license for this program to enable this feature.

TPC48 - ERROR
This value is limited to the range allowed by this demonstration version.

For a demonstration program, certain input ranges are limited so arbitrary input values cannot be entered. Normally, a full range of typical input values is allowed for every input accepted by the program. Action: Purchase a full-use license for this program to enable this feature.

TPC49 - ERROR
This command's values cannot be modified in this demonstration version.

For a demonstration program, certain command entry values cannot be changed from their default values. Normally, a full range of typical input values is allowed for every input accepted by the program. Action: Purchase a full-use license for this program to enable this feature.

TPC51 - ERROR
The GOTO variable does not match the current REPEAT command. Access aborted.

If the <Destination> parameter on a GOTO command is not a <Variable> parameter of the most active REPEAT command, this message will be displayed. Command execution is terminated and a new command instruction is issued. Action: Verify that all REPEAT and GOTO variable references are correct and re-issue the LOAD command to restart the REPEAT loop process.

TPC52 - ERROR
ERROR IN PROGRAM SPECIFICATION

This error occurs when an invalid <Program Name> parameter is used with the STOP command. The <Program Name> parameter must be specified following the rules for file specification outlined in Appendix G. Action: Re-issue the STOP command using the correct file

specification; or execute the STOP command without a <Program Name> and do a system directory to determine the proper name for the desired program.

TPC53 - ERROR
The REPEAT specification is not valid. Check manual. File access aborted.

This error occurs when any of the parameter values for the REPEAT command are not acceptable. For example, it could be that the <Variable> used is already in use or not an alphabetic character, or that the range and increment variables are not valid numeric values. Action: Re-issue the REPEAT command using proper parameter values.

TPC54 - ERROR
Only X distinct time period range(s) is(are) allowed. More have been defined.

The PERIODS command allows only five distinct time periods of counts to be defined. This requires five pairs of start and stop times to be entered. If more than five time periods are entered, this error will be generated. Action: If more than five periods were actually counted, they will need to be separated into two distinct runs of TURNS or merged into fewer time periods with zeros entered for some of the count intervals which were not counted. If this is not the case, check for the proper entry of each of the start and stop times on the PERIODS command following the count interval.

TPC55 - ERROR
The second time of the period cannot occur before the first time. Re-enter.

The PERIODS command allows the entry of pairs of start and stop times to define the range of time each count period encompasses. The first number entered for each pair defines the start time, entered in 24-hour time notation. The second time of each pair defines the end time of the period, and must not be less than the first time of the period. If the second time is less than the first, this error is displayed. Action: In this case, correct the PERIODS entry so that each stop time is no earlier than its associated start time.

TPC56 - ERROR
The time that was entered is not a valid time entry. Re-enter.

If the time entry of the PERIODS command does not match the count interval entered, it is designated as an invalid time entry by this error message. For example, if 15-minute counts are to be entered, every time entry of the PERIODS command must end with 00, 15, 30 or 45. If 60-minute counts are to be entered, each time entry of PERIODS must end with 00. Action: Check the count interval used (first parameter of PERIODS) and make sure the times used on PERIODS match the constraints listed above or round entries to the nearest value that matches the above constraints.

TPC57 - ERROR
The time periods entered have created more than the max of 97 entries.

For an entire day of counts (24 hours), 96 distinct 15-minute time periods exist. If cumulative counts are performed, 97 count intervals will be needed for these counts. This is the maximum number of 15-minute intervals TURNS allows. This error is issued if it attempts to create more

than 97 count intervals, based on the time period start and stop times entered. Action: Make sure that the start and stop times entered for the time periods do not overlap, cover more than a single 24-hour period, or in any other fashion attempt to generate more than 97 distinct count intervals. Non-overlapping count periods for a single day will always fit into this limit without error, if defined properly on the PERIODS command. Attempts to combine several days' counts for a single intersection should be avoided, with this error message being a common result of such an attempt.

TPC58 - ERROR
The time periods entered cannot overlap. Re-enter without overlap.

Each of the time periods defined on the PERIODS command are not allowed to overlap in any way. If the start time is the same as or precedes any other stop time, or if a stop time is the same as or follows any other start time, this error will be displayed. Action: Check that the time periods entered do not overlap in any way. If they do, they must be entered as two separate problems to TURNS, and cannot be combined.

TPC59 - ERROR
The extra inputs for this movement entry have been ignored. Check for error.

This error is generated by either the VEHICLECOUNTS or TRUCKCOUNTS command when too many entries have been entered in the Manual Mode. If entries are being made for a given movement number, there cannot be more count entries following the movement number than there are number of count intervals defined by the PERIODS command. If entries are being made for a given time interval, no more than twelve count entries may follow the time being entered, one for each movement. Action: Check the entries made following the movement number of time, making sure the number of entries match the limits discussed above. This can be particularly tricky when entering counts for a given movement, especially when more than one time period is defined by the PERIODS command. Use the Tabular View of the Visual Mode or the ASK VEHICLECOUNTS command to see on the full-screen display what entries are expected when entering rows or columns of the count tables.

TPC60 - ERROR
xxxxx is not a valid movement number or time value entry. Re-enter properly.

The first parameter of the VEHICLECOUNTS and TRUCKCOUNTS commands must define whether the following entries are for a given movement or a given time interval. To do this, the first entry must be a valid movement number (1-12) or a valid time interval as defined by the PERIODS command. Action: If entering data for a given time interval, use the DATA or ASK command to display the valid times which have been generated by the current PERIODS command. Re-issue the VEHICLECOUNTS or TRUCKCOUNTS command with a proper movement number or time, or re-issue the PERIODS command so the proper times are defined for your count information.

TPC61 - WARNING
An INTERSECTION # must be given before this input can be made. Enter here?

This message indicates that an INTERSECTION number has not been selected prior to the entry of a data value. When an input value is entered that is intended to pertain to a specific intersection, that intersection number must first be selected with the INTERSECTION entry before the input value is entered. If this has not occurred, the program doesn't know which intersection to assign the entry value to. Action: If you know the intersection number you intend to be using, enter it in the error dialog and select Yes. In this case, the INTERSECTION command will be issued for you for that intersection. If you do not know the intersection number you wish to use, or are uncertain, select No, then use the INTERSECTION command to select an intersection from the NODELIST and re-enter the input value for that selection. In the Tabular View, make sure the Execute button is used to "execute" the INTERSECTION command.

TPC62 - WARNING
An INTERSECTION # must be given before this DATA can be listed. Enter here?

This message indicates that an INTERSECTION number has not been selected prior to the request to list a DATA value. When a data value is to be listed with DATA for a specific intersection, that intersection number must first be selected with the INTERSECTION entry before the value can be listed. If this has not occurred, the program doesn't know which intersection's data to list. Action: If you know the intersection number you intend to be using, enter it in the error dialog and select Yes. In this case, the INTERSECTION command will be issued for you for that intersection. If you do not know the intersection number you wish to use, or are uncertain, select No, then use the INTERSECTION command to select an intersection from the NODELIST and re-enter the DATA request for that selection. In the Tabular View, make sure the Execute button is used to "execute" the INTERSECTION command.

TPC63 - ERROR
This INTERSECTION number is not in the NODELIST. Add to NODELIST? ..(No/Yes)

This message is issued if an intersection number is entered that is not currently in the NODELIST. Since the purpose of INTERSECTION is to select a node number from the list in NODELIST, most often this condition indicates an invalid selection that the user will want to correct. Action: The normal response will be to select No, indicating that the intersection number entered is incorrect and must be corrected. However, there a several cases where this message can be used as a shortcut method for adding intersections to the NODELIST. In the case where it is known that the entered number is not in the NODELIST and it is desired to add it to the end of the NODELIST, select Yes and the intersection will be added to the NODELIST and selected in a single click. This can be a very effective way of building a NODELIST on the fly as new intersections or scenarios are needed, or as multiple data files are loaded into a single multi-intersection database to be saved as a single file.

TPC64 - WARNING
UTILIZATION entries > 1.0 from old data file have been inverted for HCM 2000.

This warning indicates that a UTILIZATION entry has been encountered with a value greater than 1.0, normally when a SIGNAL85 or SIGNAL94 data file has been loaded. Due to the new

technique used to define unbalanced lane utilization in the 1997 & 2000 HCMs, these values have been automatically inverted (1/x) to reflect the new definition. This message warns the user of this automatic conversion. Action: If the UTILIZATION values > 1.0 are, in fact, from an old SIGNAL85 or SIGNAL94 file, no action should be required. In any case, the user should simply make sure that this is the case and verify that the inverted results are appropriate.

TPC65 - WARNING
The SEQUENCE code for this INTERSECTION must be -1 thru -9 to use PHASEMOVS.

This warning indicates that the PHASEMOVEMENTS command was executed for an intersection whose SEQUENCES code was not in the range of -1 through -9. Action: The SEQUENCE code for the intersection must first be set to a number in the range of -1 through -9 before the PHASEMOVS command can be executed.

TPC66 - ERROR
Entry of this command is not allowed for the demonstration program.

In a demonstration version of TURNS, the intersection conditions for a warrant analysis take on preset values which cannot be changed by use of the CONDITIONS command. This error indicates an attempt has been made to use the CONDITIONS command. Action: Purchase a full-use license of TURNS to eliminate this artificial constraint. This message will not be issued in a full-use licensed version of TURNS.

TPC67 - ERROR
Path list must start/end with valid external/access node numbers. Re-enter.

When entering a PATHASSIGNMENT command for the current PATHDISTRIBUTION type of traffic, the path list must either start or end with a valid external node number, and conversely must then end or start with a valid access node. Action: For inbound distribution types, the first node of the path list must be the same as the external node number appearing on the current PATHDISTRIBUTION command, and the last node must be one of the inbound access nodes on the inbound GENERATION command. Conversely, for outbound distribution types, the first node of the path list must be one of the outbound access nodes on the outbound GENERATION command, and the last node must be the same as the external node number appearing on the current PATHDISTRIBUTION command. Check what condition is not being met and adjust as appropriate.

TPC68: WARNING
A PATHDISTRIBUTION type # must be given before this input can be made.

This message indicates that a PATHDISTRIBUTION type number has not been selected prior to the entry of a data value. When an input value is entered that is intended to pertain to a specific distribution type, that type must first be selected with the PATHDISTRIBUTION entry before the input value is entered. If this has not occurred, the program doesn't know which type to assign the entry value to. Action: If you know the distribution type you intend to be using, enter it in the error dialog and select Yes. In this case, the PATHDISTRIBUTION command will be issued for you for that type. If you do not know the type you wish to use, or are uncertain, select No, then use the PATHDISTRIBUTION command to select a type and re-enter the input value

for that selection. In the Tabular View, make sure the Execute button is used to "execute" the PATHDISTRIBUTION command.

TPC69: WARNING
A PATHDISTRIBUTION type # must be given before this DATA can be listed.

This message indicates that a PATHDISTRIBUTION type number has not been selected prior to the request to list a DATA value. When a data value is to be listed with DATA for a specific distribution type, that type must first be selected with the PATHDISTRIBUTION entry before the value can be listed. If this has not occurred, the program doesn't know which type's data to list. Action: If you know the distribution type you intend to be using, enter it in the error dialog and select Yes. In this case, the PATHDISTRIBUTION command will be issued for you for that type. If you do not know the type you wish to use, or are uncertain, select No, then use the PATHDISTRIBUTION command to select a type and re-enter the DATA request for that selection. In the Tabular View, make sure the Execute button is used to "execute" the PATHDISTRIBUTION command.

TPC71 - ERROR
BUFFER SIZE EXCEEDED...SORT ABORTED

Programs which perform substantial built-in sorting functions may encounter files whose contents require too much buffer space to be sorted. Within a TEAPAC program, it is difficult to correct this situation. Action: Attempt to reduce the amount of information being sorted; or use a system program to sort the file external to the TEAPAC program.

TPC72 - ERROR
SCRATCH FILE LIMITS EXCEEDED...SORT ABORTED

Programs which perform substantial built-in sorting functions may encounter files whose contents require too much scratch file space to be sorted. Within a TEAPAC program, it is difficult to correct this situation. Action: Attempt to reduce the amount of information you are trying to sort; or use a system program to sort the file external to the TEAPAC program.

TPC81 - ERROR
A higher Usage Level License is needed to use this command. Upgrade license.

A command or action request has been made for a function which is not supported by the Usage Level which has been licensed. For example, a design optimization function of Usage Level 2 may have been requested while using a program licensed only for Usage Level 1 which does not optimize. Also, the limits of program may have been exceeded for the Usage Level licensed, as in trying to use 25 intersections when the licensed usage level only allows 12. Action: Limit the function and/or size of the problem being analyzed to those licensed; or upgrade your licensed Usage Level to include the function and/or size needed.

TPC91 - ERROR
HELP FILE MUST HAVE STRING COUNT IN LINE 1

This error indicates there is a problem with the information in the XXXXX.CMD file which supports the running of the TEAPAC program, where XXXXX is the name of the program. This

information is not user serviceable. Action: Re-install the program from the master program disk.

TPC92 - ERROR
TOO MANY CHARS REQUIRED FOR COMMAND STRINGS

This error indicates there is a problem with the information in the XXXXX.CMD file which supports the running of the TEAPAC program, where XXXXX is the name of the program. This information is not user serviceable. Action: Re-install the program from the master program disk.

APPENDIX G

Operating System Messages and Installation Notes

Appendix G Topics

Certain aspects of program installation and execution will vary among different computer systems. This is dependent upon the operating system of the computer rather than the software installed. Run-time error codes and file specification are two of the more prominent of these aspects. In addition, control of printed output, interactive editing control and program installation are dependent on the operating system.

This appendix discusses these aspects of TEAPAC program implementation for any of the 32-bit Windows operating systems. The details discussed herein should be appropriate for any standard implementation of the these operating systems. Table G-1 summarizes the organization of this appendix.

Table G-1
Summary of Operating System Messages and Installation Notes

Run-Time Error Codes
File Specification
File Access
    Line Numbers
    File Numbers
Output Control
    Printer Control
    Disk File Output
Installing TEAPAC Programs

Appendix G Topics

File Access
Output Control
Installing TEAPAC Programs

Run-Time Error Codes

The list of standard run-time error codes for the software development system used for TEAPAC is too extensive to be produced here. The most common one is a divide-by-zero error, indicating unexpected conditions, usually where not enough information has been provided. If this or any other un-documented error is encountered and you are unable to identify and/or correct the problem, Strong Concepts may be able to assist you with the problem if enough information is available to reproduce the problem. If the problem can be reproduced, document the input conditions which existed prior to executing the command upon which the error occurs. This can be done with SUMMARISE prior to issuing the last command which generates the error, and copying this output to the printer. Transmit the printed information to Strong Concepts so that the problem can be duplicated and resolved. As a convenient alternate, send the data file to Strong Concepts via email as an attachment with an appropriate description of the problem and where to look for the anomaly in the output, if appropriate.

File Specification

There are four descriptive elements used by a TEAPAC program to define and access a disk data file. The elements are 1) the name of the disk drive and path to be used; 2) the actual disk file name; 3) the file name extension; and 4) a switch option. When these elements are combined, they constitute a file name specification which usually appears in the form of <File Name> in the documentation and help files:

<File Name> = d:\path\nnnnn.eee/s

It is important to note that a colon ":" must separate the name of the disk drive and the rest of the file specification, back-slashes "\" must be used to define a specific path on the drive or the network (the file path), a dot "." must separate the actual file name and the file name extension, and a slash "/" must separate the switch option from the other elements. The name of the disk drive-path, actual file name and file extension elements are identical to the file specification conventions of Windows. The fourth element, the switch option, is a unique element of the TEAPAC program package used to control an aspect of data file creation. Each of the four elements are discussed in detail below.

Drive-Path Designation (d:\path\)
File Name (nnnnn)
File Extension (.eee)
Switch (/s)

Drive-Path Designation (d:\path\)

The drive-path designation indicates which disk drive and/or system path should be used to find an existing <File Name> or to place a new <File Name>. Typically, drive-path designations are letters such as C: for the local hard drive, folder or sub-folder names enclosed in back-slashes, network paths starting with double back-slashes, or a combination of these designations. The length of the drive-path designation cannot exceed a maximum of 180 characters, and upper/lower case characters and spaces are allowed. If no drive-path designation is provided, the default drive-path comes from the third entry displayed in the dialog of the Options-Setup menu. This location comes from the program's CFG file on program startup, a file whose contents can be altered with the Save button of the Options-Setup dialog. The Options-Setup dialog changes dynamically as the user navigates through the File-Open and File-SaveAs dialogs

A common feature of Windows can be used to direct TEAPAC data files to another drive path. This is the Map Network Drive function. This process substitutes a network drive location for a drive designation. For example, on a typical system with an A, B and C drive, a MAPped D drive can be created pointing to a network drive elsewhere on the network. Then files on the network drive can be referenced in a TEAPAC program by simply using the D: drive. The Command Prompt SUBST command can also be used to map any folder or sub-folder to a virtual drive, not just map a drive as above. This is a particularly convenient way to get around the 180-character limit imposed by TEAPAC on the drive-path designation.

File Name (nnnnn)

This element is the actual file name of the data file and should be descriptive of the information contained within the file. The file name, including any file extension or switch (see below), cannot exceed a maximum of 70 characters. Upper/lower case characters and spaces are allowed. Since SCENARIO Condition files and certain file switch options can add as many as 6 characters to file names designated by users, it is recommended that user file names not exceed a limit of 64 characters to avoid potential problems when these tools are used. There are some special symbols which may not be used such as colons ":", dots "." and slashes "/" which are used as separators between the <File Name> elements. In order to minimize potential problems in naming files, it is recommended that only letters and digits be used in the disk file name.

File Extension (.eee)

As many as three characters may be used to describe the file extension. Typically, the file extension describes the format of a data file rather than the actual contents. In TEAPAC programs, if a file extension is not entered, the program will automatically generate ".tpc" as the default extension. The older TEAPAC file format extension of ".for" is also allowed. Use of the default extension is recommended.

Switch (/s)

When using the FILES command, the operating systems provide the capability to automatically create data files on disk. This capability also allows the unintentional creation of a file or the

accidental overwriting of an existing file without warning. In the case of overwriting an existing file, the loss of valuable data may result. In order to eliminate these potential file management problems, TEAPAC programs use two switches ("/N" and "/O") to indicate the intention of creating a new disk data file. If a data file is expected to already exist, a switch is not required.

The "/N" switch is used to automatically create a "New" data file that doesn't already exist, without any error or user query. If the "/N" option is used and a data file already exists for <File Name>, a warning message will be displayed stating that the <File Name> already exists. This protects the user from accidentally over-writing an existing file when a new file was expected. If no switch is used, the TEAPAC program will expect to find an existing data file on the designated disk drive. If there is no existing data file for <File Name>, a warning message will be displayed indicating the file can not be located. This protects the user from accidentally creating a new file when an existing file was expected to exist, probably identifying a spelling error in the file name.

If a requested file does not exist and the /N Switch is not used, the user will be prompted as to whether to allow the program to create the data file anyway. This effectively eliminates the need to use the /N Switch; the program will create a new file if prompted to do so even when /N is not used. Conversely, if a requested file exists and the /N Switch is used, the user will be prompted as to whether to allow the program to overwrite the contents of the data file anyway, even though it was thought to be a new file. In either case, a user response of "Y" eliminates the potential error condition and the program continues with the selected action. If "N" or any other response is made, the program processes the condition as an error, usually with an opportunity to re-enter the bad file specification.

The "/O" switch is used to designate an "Otherwise" or "dOn't care" condition. If a data file exists for <File Name>, the file will be used and possibly overwritten. If the data file does not exist, a new file will be created under this option. This option can also be interpreted as the "Output" option, since it is typically invoked only when the file is to be used for output, rather than input. This mode creates a file if it is needed or uses one that already exists.

File Access

All file access commands in TEAPAC programs (such as LOAD and SAVE) use line numbers and file numbers to describe where the file access is to take place. For example, the syntax of the LOAD command is: **LOAD <Line Number> <File Number>**. In order to LOAD the proper information from the data file, the proper <Line Number> and <File Number> must be specified. The <File Number> describes which of the defined FILES are to be used, while the <Line Number> describes where in the file to start the access. Each of these parameters are discussed below.

The File-Open/Save/SaveAs dialogs always work with line number 1 of file number 1; the following discussion only applies to the Advanced Files LOAD and SAVE options.

Line Numbers

Line Numbers

The line number of the file describes where in the file the access should begin. If a new file has been opened to SAVE information, the line number should be line 1 to start at the beginning of the file. When this information is to be retrieved, line 1 should be used for the LOAD command. If only one set of information is to be stored in the file, line 1 should always be used for every SAVE and LOAD performed. This is equivalent to the standard Windows functions of File-Open/Save/SaveAs.

Information may be stacked in files sequentially. For example, if the data for an analysis is SAVEd starting at line 1 of a file and takes up 50 lines of the file, another scenario can be SAVEd starting at line 51 of the file. If it also takes 50 lines, as reported by the SAVE command, this information will be stored in lines 51-100. In order to retrieve this information, line 51 should be used as the starting line number of the LOAD command. If the first scenario is desired again, simply LOAD starting at line 1 again.

Any number of scenarios or conditions may be SAVEd and LOADed to and from a file, simply by knowing at which line number the information starts. When SAVing information, it is important to either re-SAVE starting at the same line number as previously used, or to SAVE starting at the next available line number of the file. When re-SAVing information, make sure the same information is SAVEd as previously used so that it takes up the same number of lines used previously. If more lines are used, they will overwrite the beginning of the next information (if it exists), and if less lines are used they will not erase the end of the previously SAVEd information.

After any file access is completed, such as a LOAD or a SAVE, the default line number for that file remains at the "next line" of the file until another file access command is executed or another file is opened. For example, after the first SAVE above taking 50 lines of the file, the default line number for the next file access command will be line 51. If another scenario is to be SAVEd, the default line number may be used without remembering what it is. For File #1, this line number is displayed in the dialog box of the file access command. Another use of the default line number is for access of SAVEd scenarios in the same order they were SAVEd. For example, the first scenario from above can be LOADed starting at line 1 and analyzed, then the next scenario can be LOADed starting at the default line number of 51, again without remembering what it is.

Another line number that is remembered by the program is the "last line" that was used for the file by any file access command. This line number is designated by using line 0 of the file. For example, if information from the second scenario above was LOADed (starting at line 51) and the analysis determined that are error in the input existed, it could be corrected and re-SAVEd using line number 0. Since the previous file access command (LOAD) started at line 51, whether by default or actual input, the following SAVE 0 command will start at line 51 again, effectively re-SAVing the information over the previous information with the corrections. In this sense, a

repeated series of **LOAD *** and **SAVE 0** commands will LOAD the next information from the file, then re-SAVE any changes made before LOADing the next information.

File Numbers

The file numbers used in file access commands such as SAVE and LOAD refer to the position in which the file name desired exists on the current FILES command. The FILES command can carry up to five files simultaneously and the file number assigned to each is the position of the file name in the FILES list. For example, if existing conditions for an analysis are stacked sequentially in a file called EXIST and optimized conditions are to be stored in a file called OPTIM, each could be open at the same time by using the **FILES EXIST OPTIM** command. Since EXIST is the first file in the file list, it will then be referred to as file number 1 by subsequent file access commands. OPTIM is the second file name in the list, so subsequent file access commands will use file number 2 for optimized conditions.

For example, using this situation, each scenario of existing conditions would be retrieved by using the command **LOAD * 1** and each set of optimized conditions would be SAVEd by using the command **SAVE * 2**. If the optimized conditions are to be retrieved while the same FILES command is in effect, the first scenario would be retrieved by a **LOAD 1 2** command and subsequent scenarios would be retrieved by **LOAD * 2** commands.

The file number used only applies to the current FILES list in effect, and need not be the same every time the files are used. For example, if the above optimized scenarios are to be retrieved on another day and the existing conditions are of no concern, the **FILES OPTIM** command can be used to define OPTIM as file number 1, then the optimized scenarios can be retrieved with **LOAD * 1** commands. Furthermore, since file number 1 is the default file number when executed from the keyboard and the next line number is always the default line number, the entire default **LOAD * *** command can be used, making the LOADing as easy as possible.

Output Control

Within a TEAPAC program it is possible to redirect output display on the screen to other output devices. The most common use of this function is to direct output to the printer; however, it is also possible to direct output to disk files. This section discusses the methods of redirecting output to these devices.

Printer Control

Any of the results generated by a TEAPAC program will appear in a Results window from which they can be printed. The Results window has a File menu from which the Print command can be selected. This will direct the program output in the Results window to the default printer. The Ctrl-P key may also be used as a shortcut key to print the Results window. From the main menu,

the File-Print (Ctrl-P) selection will print a copy of the last output seen in the Results window. This last output can be viewed with the View-LastOutput menu command.

The PrintSetup options of these File menus can be used to select specific printers, as well as printer options like number of copies, print to file, print both sides, etc. prior to issuing the File-Print command. The SetupAndPrint option performs both functions with a single menu selection. The default printer can be set outside of the TEAPAC program by selecting the Printers folder of My Computer, selecting the desired printer, and clicking the Set_As_Default option in the File menu.

Disk File Output

TEAPAC programs have several options for directing program output to disk files. In the Results window the File-SaveAsText menu option can be used to copy the contents of the Results window to a file named and located by the subsequent dialog entry. This file is an ASCII text file which can be opened by any text editor. Its default extension is .txt. The Edit-CopyAll menu option will copy the entire contents of the Results window to the Windows clipboard which can then be used by any other Windows program such as a text editor or word processor. The Edit-Copy menu option will copy to the clipboard only that part of the Results window which has been selected by dragging the mouse cursor over a small portion of visible text. In the event that too much output has been generated to be displayed by the Results window, as in the case of output from a control file, the SaveAsText file will contain all of the output even though it cannot all be displayed. Some printer drivers and/or Windows printing systems may also offer other alternative ways to direct printed output to a file, although this will normally not result in a strict ASCII text file like the options above.

Installing TEAPAC Programs

Installation of TEAPAC programs follow the normal Windows practice of running the Setup.exe program from the selected program folder of the distribution CD-ROM. Demos and updates downloaded from the internet install the same way using the downloaded .exe file such as S2Kw32.exe for SIGNAL2000. The installation process prompts the user for information about the installation folder, etc. and performs all the necessary configuration of the Windows environment, including icon creation and un-install options in the Control Panel. The TEAPAC Menu is automatically installed as a part of the process, and the default .CFG files are also created.

The default .CFG files (whose contents can be reviewed and changed from the Options-Setup menu) contain the default installation path name for the most recent supported version of any host program which works in conjunction with the TEAPAC program (e.g., HCS+ for SIGNAL2000, PASSER-II for PREPASSR, TRANSYT-7F for PRETRANSYT, CORSIM for PRENETSIM, etc.). These paths should be modified, as necessary, to reflect the actual installed location of the host program. The same is true of the TEAPAC.CFG file which directs the TEAPAC Menu where to find non-TEAPAC programs. (if edited externally, TEAPAC.CFG must be edited with a text editor.) The program will look for the host program before an

EXPORT AUTO is performed, and will issue a message if it cannot be located as specified. In the event that a host program uses a name for the required executable file which is different than that expected by the TEAPAC program, the desired executable name can be added at the end of the path in the Options-Setup dialog (or the .CFG file directly).

All TEAPAC programs are designed to co-exist in the same installed folder, and work best together when installed this way. If a TEAPAC program is to be re-located to a different folder on a system, it is highly advised that it first be un-installed using the Add/Remove Programs dialog in the Control Panel, then re-installed to the desired location. Network installations must take care that all files and directories used have correct read/write privileges for the users.

A P P E N D I X H

Addenda

Appendix H Topics

Appendix H provides a location for recent release notes and addenda which may be published after the official release of this documentation. This appendix can also be used to store printed copies of new release notes for updated versions of the software, as produced by the Help-RecentChanges menu or the MESSAGES command, for off-line reference.

Appendix H Topics:

:SIGNAL2000 Ver 2.81 27MAY08

Build 11 - 27MAY08

>HCS+ Export Enhancements.

It has been discovered that the intersection numbering defined in the HCS+ XML data file format will only accept an intersection numbered #1, so intersection #1 is now always exported regardless of the actual intersection number in the SIGNAL2000 network. It has also been discovered that an ampersand (&) in a text field must be handled a special way in the XML file, so this method is now employed for any occurrence of an ampersand in the user's text strings.

>Better Terminology in Permitted LT Output Report.

Inspection of the 1-lane and multi-lane designations in the permitted left turn output report (HCM Supplemental LT-Factor Worksheet) has indicated that the terminology was confusing and likely to be interpreted in the reverse of its intent, so the use of the terms '1lane' and 'multi' in this report has been swapped accordingly.

>Better formatting for Detailed (cycle) output for DESIGN 0.

The Detailed output report for the DESIGN 0 optimization (for additional cycle optimization results) has been improved so it shows all of the results for each cycle which was optimized.

>Dialogs identify need for consistency between Yellowtimes & ReqClearances.

The dialogs for GreenTimes and YellowTimes have been updated with additional text to clarify the importance of maintaining a consistency between the YellowTimes and ReqClearances entries. This consistency is especially important when the entry format is Converted from By-Phase to By-Movement and when Exporting to ring-based software.

>Generic changes made to all Ver 7.81 TEAPAC programs.

Allow negative percentage on ASSIGNMENT for Passbys and Diverted trips.
Use Shift while dragging mouse to define development area on network display.
Dialogs identify need for consistency between Yellowtimes & ReqClearances.
Display dummy node dot and node number if it is current node or in Subsystem.
Note in CrdSysMgmt dialog that NewLinkDist button assumes coords are in feet.
Able to save from OpenIntoEdit if it was first file opened into program.
NOTE shows 'Issue X Not Selected' when case selection does not select an Issue.
File-OpenMerge does not allow existing Network data to be overwritten by zeros.
File-SaveAs to an existing file name with Scenario conditions doesn't hang.
File-SaveAs shows file type of current file & better file type descriptions.

:SIGNAL2000 Ver 2.80 25APR07

Build 00 - 08JUN07

>HCS+ Export Implemented, Now for Both Signalized and Unsignalized Locations.

The EXPORT function has been updated to use the native HCS+ data file format (XML-based), and has been expanded to include exporting for both signalized and unsignalized intersections defined in the complete TEAPAC network of intersections. This is now the default for the Export function, but as before, older versions of HCS can still be exported to by using the file extensions specific to those versions. The mapping of descriptive intersection information to HCS+ has also been modified to take advantage of the new capabilities in HCS+ in this regard. Details of these changes are in the Help topic for the EXPORT dialog.

>Status Window for DESIGN Re-enabled.

The status window which shows the progress of the DESIGN optimization has been re-enabled so that it shows the current cycle length and sequence code which is being optimized, thereby informing the user how much of the optimization has been completed and thus how much remains. The dynamic nature of the status window was disabled in a previous release of the program.

>Long File Names and Longer Path Names Implemented, Plus New File Format.

All aspects of TEAPAC data file storage, including SCENARIO condition files, have been extended so that file names can have as many as 70 characters in their names, and file path names can have as many as 180 characters, both including upper or lower case characters and spaces. Since SCENARIO condition files and certain file switch options can add as many as 6 characters to file names, it is best if user-entered names are no more than 64 characters.

A new, higher capacity data file format with a new file extension (.tpc) has been introduced which will be used by default for all new files created by all TEAPAC programs. This format is text-based like the old .for format so it is still easy to see what is in a file, as well as write such files from other programs, but with a look to the future this format has line length maximums of 256 characters per line (254 useable) instead of the more limiting maximums of the .for format which had maximums of 128 characters per line (80 useable). The old format can still be read and written simply by continuing to use the .for extension, but users are encouraged to convert files to the new format simply by saving .for file with the new .tpc extension (then archive the .for files so they are not used by mistake). The long file names and paths mentioned above are valid for either extension.

>New User Discussion Forum Is Accessible Directly from the Help Menu.

The new User Discussion Forum which has been implemented for TEAPAC users and is available 24/7 for posting questions and searching through answers to previous questions can now be accessed directly from the Help menu of the program. The Forum can also be accessed directly using any internet browser at www.StrongConcepts.com/Forum.

:SIGNAL2000 Ver 2.71 08SEP06

Build 07 - 25JAN07

Scroll down to 'Ver 2.70 07NOV05, Build 07 - 11NOV05' below for the major changes which were implemented for the original Visual TEAPAC release.

>Default Value for DESIGN Optimization Changed.

The default value for the DESIGN optimization control parameter has been changed from 0 to 1 so that a default optimization will now always generate a capacity analysis of the top-ranked phasing and cycle length combination without changing the default.

>SCENARIO Program Makes its Debut.

SCENARIO is a new Visual TEAPAC program that can create multi-scenario data files either from scratch or from data files of earlier versions of TEAPAC. Users can 1) select from pre-defined typical scenario structures like multiple volume conditions or multiple timing plans, 2) create completely unique scenario conditions for their analyses, or 3) customize a pre-defined scenario structure to meet their specific needs. The primary advantage of using SCENARIO is that all the scenario data is saved without dangers of duplicated data which often occur when scenarios are managed by the typical use of File-SaveAs.

The SCENARIO program also functions as an automatic plugin for all other Visual TEAPAC programs so that each program automatically understands the SCENARIO file structure which has been created, and at no additional cost (see below).

SCENARIO can easily define both single-issue and multi-issue conditions, and any data dialog can be assigned or re-assigned to any defined issue for as many as five independent, mutually-exclusive Issues. 25 Conditions can be defined for each Issue. For example, a very common and simple single-issue scenario would be having multiple volume conditions for one or more intersections for which capacity analysis, intersection design and/or signal timing optimization would be needed. Other examples of a single-issue analysis could be multiple years of traffic count data for TURNS or WARRANTS, or multiple years or zones of land use for SITE's projected traffic estimation.

Multi-issue scenarios could be combinations of any of these, where the variation of one variable is independent of the others. Another example of a multi-issue scenario could be where one Issue is changing volumes based on the time-of-day and/or day-of-week while the other Issue is independently changing intersection geometrics which depend on differing funding possibilities.

>SCENARIO Support in All Visual TEAPAC Programs.

All Visual TEAPAC programs have been updated so that support for multi-issue data files created by SCENARIO is automatic and seamless. The SCENARIO program serves as a plugin to the other Visual TEAPAC programs so that

they automatically support the SCENARIO-structured files for both File-Open and File-Save. A new File menu option labeled Get-Scenario-Case allows the user to select any of the Conditions for all of the Issues which have been created, and any subsequent changes to data which are made are automatically saved in the correct Condition files which have been defined. SCENARIO has also been added to all LinkTo menus so that SCENARIO is immediately available to modify the defined scenario structure, as necessitated by changing project assumptions.

>Generic Enhancements Made to All Visual TEAPAC Programs.

A number of additional generic enhancements and fixes have been made to the original Ver 7.00 releases of Visual TEAPAC and are collectively included as Ver 7.01 Build 07. These are documented below. Ver 7.01 Build 07 changes are free updates for Ver 7.00 licenses.

Data entry dialogs that don't apply to dummy nodes have been modified so that if they are inadvertently displayed while pointing to a dummy node they will not display unpredictable values or cause the program to crash.

The LinkTo menu has been adjusted so that if no data file path has been defined it will attempt to use the program's file path, but will not crash if neither of these is defined. The file menu options for Open, SaveAs and IntoEdit have been adjusted similarly for the condition when no data path has been defined.

A bug has been fixed that could cause a crash when clicking within an output being displayed at a zoomed-out scale on some low-resolution monitors.

:SIGNAL2000 Ver 2.70 07NOV05

Build 28 - 28AUG06

Scroll down to 'Ver 2.70 07NOV05, Build 07 - 11NOV05' below for the major changes which were implemented for the original Visual TEAPAC release.

>V7.00.28: Generic Enhancements Made to All Visual TEAPAC Programs.

A number of generic enhancements and fixes have been made to the original Ver 7.00 releases of Visual TEAPAC and are collectively included as Ver 7.00 Build 28. These are documented below and use heading lines that begin with V7.00.28:. In addition, minor program-specific changes have been made, as summarized here and detailed in the program's own specific list of updates and changes. Ver 7.00 Build 28 changes are free updates for Ver 7.00 licenses.

>V7.00.28: Number of Access Drives Increased From 5 to 10 for SITE Computations.

The permitted number of driveways which provide access to a development area for SITE computations has been increased from 5 to 10 in all TEAPAC programs, allowing greater flexibility in modeling all driveways which may exist or be proposed for a development. Along with this change comes a quicker way of entering driveway locations by combining the intersection leg direction (N/E/S/W) with the node number of the drive, such as 1N or 132E.

>V7.00.28: Input Limit for VOLFACTORS Adjusted for Consistency with Save.

The largest VOLFACTOR which can be saved in a TEAPAC data file has always been 9.99, but it's been recently noticed that the input dialog error checking permitted factors as large as 20.0 without an error, resulting in subsequent problems if an attempt was made to save such an entry. The input error checking has been modified to match the save limitation to resolve this problem. At the same time, the discussion in the documentation has been modified to reflect the same precision of save accuracy to avoid any further confusion.

>V7.00.28: Multiple Copies of a Program Can Be Open Simultaneously Again.

The source of a problem which has recently prevented multiple copies of any given program from being open at the same time, such as when comparing alternatives side-by-side. This problem has been resolved and the ability to have multiple copies open simultaneously has been re-enabled.

>V7.00.28: Minor Fixes to Drag-and-Drop Network Interface.

An occasional problem connecting T-intersections properly when bend nodes were present in the network has been resolved. Build 21 versions of the programs would notify the user of the problem immediately upon creation of a link under these circumstances. If an earlier version was used to create the network, the problem is easily detected (if it exists) with the Analyze function in the new Coordinate System section of the Setup button dialog in the main window. the problem would manifest itself with upstream connections to the wrong node and/or incorrect distances. Creation of most T-intersections were not affected by this problem.

If an old TEAPAC data file saved from a program prior to Visual TEAPAC was opened using a LinkTo, drag-to or from a command line, a crash could result when an attempt was made by the program to update the Nodelist format to the new save format. This problem has been resolved.

Build 21 - 27JUL06

Scroll down to 'Ver 2.70 07NOV05, Build 07 - 11NOV05' below for the major changes which were implemented for the original Visual TEAPAC release.

>Improved Modeling of Unopposed Left Turns.

For 'unopposed' left turns, the right turn model is no longer used (as in previous HCM versions) since this condition is handled properly by the Ped-Bike model for left turns. This change will only produce noticeably different results when a left turn is both 'unopposed' by vehicular traffic (this is not the same as a protected movement) and opposed by a significant volume of peds or bikes.

>V7.00.21: Generic Enhancements Made to All Visual TEAPAC Programs.

A number of generic enhancements and fixes have been made to the original Ver 7.00 releases of Visual TEAPAC and are collectively included as Ver 7.00 Build 21. These are documented below and use heading lines that begin with V7.00.21:. In addition, minor program-specific changes have been made, as summarized here and detailed in the program's own specific list of updates and changes. Ver 7.00 Build 21 changes are free updates for Ver 7.00 licenses.

>V7.00.21: New Coordinate System Management Features.

A new set of options to help manage the network coordinate system for any given data file has been added to all programs that use the Visual TEAPAC drag-and-drop network editing and display (all TEAPAC programs except NOSTOP, TED and TUTOR). The options appear in a new dialog which is displayed when the Coord Sys button is pressed in the network Setup dialog.

The Coordinate System Management dialog offers three main function - 1) to Analyze the current network for possible coding errors such as improperly-connected nodes and scaling issues, 2) to create a New Coordinate System by shifting and/or scaling the current coordinate system, and 3) to compute New Link Distances based on the current coordinate system. For the Analyze function, a percentage error can be input to define the threshold which identifies potential scaling problems between the coordinate system scale and each link's entered distance, and an option can be selected to check the approach angle of each intersection leg.

One of the motivations for this new option is to be able to identify and adjust network coordinate systems from older TEAPAC programs which exercised the option to specify the units of the coordinate system in something other than feet. Although this is still possible, it can be problematic with the new drag-and-drop Visual TEAPAC interface, and is not recommended. In combination with the new Manual Distance option described below and the functions of this new dialog, old coordinate systems can be easily converted for more predictable use under the new Visual TEAPAC methods.

>V7.00.21: New Manual Distance Option Added to NETWORK Dialog Entry.

A new option can be selected in the NETWORK dialog individually for any given link of the network that indicates that the distance entered for that link is intentionally inconsistent with the network coordinate system and apparent network scale. Links which have this option selected are specifically excluded from the computation of the average coordinate system scale used and reported in the network Analysis function described above. Although not recommended, selecting this option allows a link's distance to be inconsistent with the coordinate system without adversely affecting the management and checking of the rest of the network.

In addition to this option, the NETWORK dialog also shows the calculated link distance based on the coordinate system (and the average coordinate system scale, if not equal to 1.0), and if this calculated distance is outside of the allowed error specified in the Coordinate System Management dialog, it is displayed in red. The Manual Distance option status is also shown in

all data summaries which include NETWORK data, and new distances which are required due to any network editing are now always based on the coordinate distance, unless a link is previously marked for Manual Distance.

>V7.00.21: Automatic Network Relationship Checks Made.

The new Analyze function of the Coordinate System Management dialog mentioned above is invoked automatically any time a data file is Opened or Saved, or any time NETWORK or NODELOCATION information is changed (either via drag-and-drop actions or direct keyboard entry), thereby giving immediate feedback when a network definition problem could be corrupting an analysis. The Analyze function is also invoked prior to other program functions which make significant use of the spatial arrangement of the network, such as Exporting in PRENETSIM, PRESYNCHRO and PRETSPPD and FindPaths in SITE.

>V7.00.21: Frequency of Automatic Update Check Can Be Set By User.

A new user entry can now be made which controls the number of days between automatic checks for program updates. The entry can be found in the Help-Check_For_Newer_Updates menu dialog. With this new feature, the maximum frequency of automatic checks is once per day, not every time the program is run. Automatic checks can be disabled by entering a frequency of 0 days, but this is not recommended (checking for updates every 10-30 days is recommended).

>V7.00.21: Improved Initial Zoom-All View for Large Coordinate Range.

The initial Zoom-All display for a network when a file is opened has been improved for all networks, especially those with a wide range of coordinates, such that the zoom level used is more appropriate for all combinations of networks and display resolutions.

>V7.00.21: Improved Network Editing Features.

A number of enhancements have been made to network editing functions to improve the response to various user actions, as follows. If a new link connection will over-write an existing leg of a node, the user is warned and given the option to select another leg or abort. If a new link creation is aborted for any reason, any new dummy nodes created as part of that process are deleted (including clicking on the network without dragging, now deleting the single node which was previously created). If a third leg is added to a bend node as part of a new link creation, the bend node is converted to a real node (and re-numbered accordingly). If deleting a node removes one leg of a bend node, the bend is converted to an external node. Default source movements for a new link which connects existing nodes with a diagonal are determined more reliably. Left-click can be used while in the Create New Link mode to select the current node.

>V7.00.21: Fixes to SIMULATION Dialog.

The 'Use TRANSYT or PASSER Actuated Model' option of the SIMULATION dialog is now both properly selectable without any error messages, and displayed properly in the dialog, and a random glitch which garbled part of the main window Network display when the SIMULATION dialog opened has been fixed.

>V7.00.21: Make Help File Useable When a Data File is Double-clicked.

A problem locating the .HLP file when a user data file was double-clicked in Windows Explorer to open it has been fixed.

Build 14 - 20APR06

Scroll down to 'Ver 2.70 07NOV05, Build 07 - 11NOV05' below for the major changes which were implemented for the original Visual TEAPAC release.

>New OUTPUT Option for 2-Page Capacity ANalysis Summary.

A new OUTPUT option called 'Input' has been added to include the Input Worksheet (only) with the Capacity Analysis Summary output report, resulting in a compact, 2-page summary of both input and results for a capacity analysis.

>Critical V/C Added to Capacity Analysis Summary.

Critical v/c has been added to the top of the Capacity Analysis Summary output report as an additional measure of intersection performance potential. User's are cautioned in the documentation to recognize that critical v/c is a measure of performance potential, not actual performance, since the value of the result assumes signal timings balance the critical v/c ratios is independent of the actual signal timings.

>V7.00.14: Generic Enhancements Made to All Visual TEAPAC Programs.

A number of generic enhancements and fixes have been made to the original Ver 7.00 release of Visual TEAPAC and are collectively included as Ver 7.00 Build 14. These are documented below and use heading lines that begin with V7.00.14:. Ver 7.00 Build 14 changes are free updates for Ver 7.00 licenses.

>V7.00.14: Color Selection Added to Options Menu.

The Options menu now provides a Colors option for selecting colors which are used when generating formatted output reports and the main window network display. Any selections made are retained and used during future program sessions. Most of the default colors for formatted output reports are taken from the user's desktop color scheme (DisplayProperties-Appearance), so changing the color scheme will automatically change the output colors used when the defaults are

selected. All colors selected, including actual selections and defaults, are displayed in the Color management dialog produced by the Options-colors menu selection.

>V7.00.14: Browse Button Added to Select a Bitmap File.

A browse button has been added to the Network Display and Edit Management dialog which is displayed when the Setup button of the main window is pressed. This can be used to select a bitmap background file in the data file folder as an alternative to simply typing the file name in the entry field.

>V7.00.14: INTERSECTION Dialog Options Added.

The INTERSECTION dialog which is used to select the 'current' node has been significantly enhanced with several new features, as follows. A check box enables the inclusion of dummy nodes in the drop-down list so dummy nodes can be selected from the dialog; and nodes in the drop-down list can be ordered in any of three arrangements - the order they appear in the NODELIST, numeric order by node number, or alphabetic order by intersection description.

On a related note, the network display is now updated any time a new current intersection is selected, including when it is entered from the Manual Mode, when it is entered from file input, etc. Also, when a dummy node is selected as the current node, it is always highlighted in the network display, even when the zoom level is such that other dummy nodes are not displayed.

>V7.00.14: Option Added to Delete All References to Deleted Node.

When a node is deleted or cut from the network, either from the main window network display or from the NODELIST dialog, a prompt to verify the deletion is now always issued, and the prompt now includes a new option to include the deletion of all other references to the deleted node elsewhere in the network. The option to delete all references is pre-selected by default on each deletion, but can be de-selected in the prompt dialog box.

On a related note, the manipulation of nodes in the NODELIST dialog has been extended to include dummy nodes as well as real nodes, offering greater flexibility in managing the entire node list from this dialog. A problem with the Copy and Paste functions (to and from the clipboard) has also been fixed.

>V7.00.14: Improved Support for PDF Creation.

Difficulties producing PDF files for formatted output reports with certain PDF writers have been resolved.

>V7.00.14: Improved Constraint In Use of SUBSYSTEM Function.

The use of the drag function in the main window network display to create or edit a SUBSYSTEM has been constrained for better consistency with the allowed use of the SUBSYSTEM feature based on the program's licensed Usage Level. This prevents inadvertent setting of the SUBSYSTEM which then causes an error when opening a file which has this feature saved.

>V7.00.14: Maximum Link Length Increased from 9999 to 32000.

The maximum link length allowed by all TEAPAC programs has been increased from 9,999 feet (<2 miles) to 32,000 feet (> 6 miles), and a warning message is now issued if a link is created in the main window network display that exceeds this limit.

>V7.00.14: File-OpenMerge Function Enhanced.

The File-OpenMerge function has been enhanced in several ways, as follows. First, if a file being merged contains information about a bitmap file and its scaling, this information is ignored in deference to the bitmap/scaling information currently in effect in the program. The help strings for this function have also been updated, and the function is initialized more completely each time it is used to avoid overlap with responses to previous error situations.

>V7.00.14: Help File Formatting Restored to Previous Style.

The numbering of the indented paragraphs in the Notes section of Appendix B of the Help file has been restored, as appeared previously.

>V7.00.14: Minor Cleanups and Fixes Implemented.

A number of (mostly internal) cleanups and fixes have been implemented for more reliable operation of Visual TEAPAC programs. Most of these will not be noticeable to users, but a couple will resolve certain problems a few users have experienced. For example, opening an old TEAPAC data file which does not contain valid NODELOCATION entries for each intersection will not crash, and moving a bend node under certain conditions will not cause the program to close prematurely.

Build 07 - 11NOV05

>Visual TEAPAC - A Whole New Way of Seeing TEAPAC.

All 13 modules of the TEAPAC suite of programs have been upgraded to the Visual TEAPAC (Version 7) interface. Primarily, this means each program sports a much more visual input and output system to make entering and viewing data for the analysis network much easier and to make the resulting output reports clearer and easier to read. The general aspects of the two major enhancement areas, visual input and visual output, are described below, followed by the many other supporting enhancements that go along with the Visual TEAPAC upgrade.

When combined with the unparalleled 1-file, 1-click, 500-intersection, completely seamless data sharing introduced with each of the 13 TEAPAC2004 (Version 6) programs, Visual TEAPAC provides an unmatched experience of fully-integrated visual traffic engineering and traffic planning software. Read on for the details.

>Visual TEAPAC - Graphical Input and Display of Analysis Network.

All TEAPAC programs (except NOSTOP and TUTOR) now provide a drag-and-drop user interface as a way to create and/or display the study network in the main window of the program. The network can be drawn schematically or to precise scale with the aid of an underlying grid, or a bitmap can be displayed under the network to make drawing easy and/or display of the network more meaningful. The bitmap file can be an aerial photograph, a street map, as-built drawings, or any other such display which would be helpful, and this bitmap is exported to third-party program such as CORSIM and TRANSYT as permitted.

Streets can be drawn by clicking on the grid or scaled bitmap and dragging across the extent of the street section, creating analysis intersections where the new street segment crosses existing street segments. The Setup button can be used to identify the bitmap, scale the bitmap and establish an axis origin, either before the network is drawn or afterwards for pre-existing data files. Special display adjustment modes allow quick re-orientation to new bitmaps, such as when using higher-resolution bitmaps for a zoomed-in study area versus a regional area bitmap.

Dummy nodes are automatically created to orient external legs of intersections around the periphery of the study network, and internal dummy bend nodes are easily created for better network representation between analysis intersections. Proper treatment of all dummy nodes (externals and bends) are fully integrated into all of the TEAPAC application programs, as well as the eleven+ third-party programs to which TEAPAC analyses can be exported. Dummy nodes do not count against the maximum number of intersections allowed by each Usage Level.

Intersections and dummy nodes are easily moved within the network by simply dragging them across the grid or bitmap, with the option to freeze the associated link distances, or have them adjust automatically as they are moved.

The network view is easily adjusted with buttons for panning in eight directions, zoom in, zoom out, zoom all to show the entire network, and a rubber-band selection to outline the desired zoom-in area. The display of either the bitmap or the network is easily toggled on or off, as required, and the current intersection for subsequent dialog data entry or analysis is made by simply clicking the intersection. Intersections can also be selected by a right-click which opens a popup menu with all the data entry and data analysis dialogs immediately available, either in Normal View or Tabular View (use F3 to toggle the view). The popup menu also allows the renumbering or deletion of the selected node. Dragging a rubber-band selection box around a set of intersections can be used to define or add to (with Ctrl key) a subsystem of intersections for subsequent analysis.

The on-screen shortest-path FindPath assignment function of the SITE program is now performed in color directly on the main-window graphics network display, including the bitmap background, providing helpful visual cues while performing the assignment process.

The on-screen Startup Help? button provides immediate assistance for all of the functions described above. Visit www.StrongConcepts.com for examples of the new graphical input front-end now found in Visual TEAPAC.

>Visual TEAPAC - Enhanced Graphical Output Reporting.

All TEAPAC programs now feature enhanced, graphical output reporting for all results produced. Output reports now make full use of color and graphics drawing for arrows, phasing diagrams, permitted movements, time-space diagrams, intersection diagrams, cycle optimization graphs, daily count variation graphs, etc. All reports are printable on any color or black & white printer supported by Windows, including PDF writers. Any graphics output page can be copied to the clipboard as a bitmap so it can be pasted into other applications. The prior version's text-only results are still viewable alone or in parallel with the graphical results, and selected text can be copied to the clipboard or saved to a text file for subsequent use, as before. In Visual TEAPAC, you are no longer limited to the old, archaic, hard-to-read character graphics which was used when TEAPAC was originally created (what did your computer look like 30 years ago?).

All output reports use shades of color from the desktop theme/style setting to highlight the results, including report titles, report sub-sections, column headings and alternating output lines. The proportionally-spaced, sans-serif Tahoma font is used for easier readability, including right-justified numeric results in columns.

Viewing options include zoom in, zoom out, zoom all to see an entire page, rubber-band selection to zoom in, drag the page to scroll and click to re-center. Text strings can be searched for within one or many pages of results and multi-page results can be quickly scanned with controls to advance to the next or previous page, the next or previous report, or the beginning or end of all results.

Visit www.StrongConcepts.com for examples of the new graphical output back-end now found in Visual TEAPAC.

>Other Generic Enhancements Found in All Visual TEAPAC Programs.

Many other generic enhancements have been made to the Visual TEAPAC user interface which is now included in every TEAPAC program. These include:

-- Windows XP style buttons, drop-down lists, scroll windows, etc.
-- all Edit and Results menus can be accessed by right-click.
-- all demos allow at least 4 intersections to be entered and analyzed.
-- license keys are valid for any older version of the same program;

license info displays in Help-About, including site license address.
-- leading W removed from all program file names for easy recognition; LinkTo and Menu looks for new name first, then old name with W, for backward compatibility with older versions of other TEAPAC programs.
-- default node to renumber is the current node, not 0.
-- Startup Help button is located in main window and now in Help menu; StartUp.txt can be modified by user with virtually unlimited size.
-- View-Network and Options-Graphics menu options have been removed.

>Program-Specific Enhancements Included in Visual TEAPAC Upgrade.

Timings provided or optimized 'by movement' are displayed with a new ring-based display in the capacity analysis report. New options (TrapOk, MultiOk & Unrestricted) for the Permissives dialog allow both the analysis and optimization of two special-case permitted left turn conditions - the left turn trap and multi-turn-lane permitted operations. The message that displays each time an unsignalized intersection is skipped in an analysis can now be disabled. Warning messages that display when high turn percentages are encountered are automatically omitted when the sum of the turn percentages is 98% or higher, such as at T-intersections or special conditions with dummy through movements. Dummy nodes are skipped without any messages when all intersections are being analyzed, and dummy node conditions are reported in abbreviated form at the end of a Summary of Parameter Values produced for all intersections.

SIGNAL2000 output reports which are significantly enhanced by the new color-graphics results produced by Visual TEAPAC include: all phasing displays, clearly showing permitted movements and critical design movements, either in HCM 'by-phase' style or ring-based 'by-movement' style; the Capacity Analysis Summary boxes for each approach; and the intersection data summary diagram.

:SIGNAL2000 Ver 2.61 23MAY05

Build 12 - 30SEP05

>Field Width Error Detection Modified for More Useful Performance.

A new error check was recently introduced to warn a user that too many characters for an input field had been entered and that the entry would be truncated. The aggressive response to this condition (ignoring the entry entirely) has been toned back, now accepting the truncated input with a similar warning. This reduces the potential for the need to re-type an entry which may be perfectly fine in its truncated form, or require only minor editing to correct instead of complete re-entry. The new error check has also been eliminated for any entries of the GROUPTYPES dialog, most of whose possible entry values can typically exceed the actual allocated input field width.

Another effect of the overly-aggressive error check was that certain drop-down list values in a number of dialog boxes had pre-programmed entries which exceeded the input field width, thus preventing them from executing properly. These included drop-down lists in the OUTPUT, CONDITIONS, GENERATION and PATHDISTRIBUTION dialogs. The field widths of all of these entries have been modified to accept the full drop-down list pre-programmed entries.

>Extra Warning Message Eliminated When Opening New Files.

If a user is warned about unsaved data or results values when a new file is about to be opened, with an option to first save the values, certain circumstances could cause the same message to be re-displayed a second time, regardless of the user response to the first message. This duplicate warning message has been eliminated.

>Debug Value Removed from Display for Text Search Function.

A spurious debug value was inadvertently left in the production version of the program, displaying each time a text string is searched for in any output window or edit window. The debug display has been removed.

>Key Files Are Now Valid for All Prior Versions of Program.

The key file processing logic has been enhanced to allow a given key file to be used not only for various builds and minor updates for the licensed version, but also for any version of the program prior to the licensed version. This minimizes the hassle of multiple key file management when multiple versions of a program are being used, for example, to maintain consistency in results throughout the course of a project which was begun with an older version of a given program that has been updated.

Build 10 - 04AUG05

>Increased Precision for Default Lane Utlilization Factors.

The default lane utilization factors which are used when an entry of 0.00 is made have had their precision increased from two decimal places to three decimal places to match the precision found in Exhibit 10-23. This change will have very slight impacts on results of SIGNAL2000 capacity analyses, but should be considered more faithful to the HCM 2000. Entered lane utilization factors must still be limited to two decimal places of entry.

>Print Problem Resolved from Tabular View.

Difficulties experienced by some users attempting to print results when using the Tabular View have been resolved.

>Improved Phasing Display in Dialog Boxes.

The currently-selected signal phasing for an intersection which is displayed in some dialog boxes has been improved so that improperly-coded permitted left turns display differently than expected to indicate the error in coding.

Build 00 - 23MAY05

>New Message Warns User That Calculated and/or Imported Values Have Not Been Saved.

A new message has been created which warns a user when calculated and/or imported values will be lost when the program is closed or File-New is used. This provides a check against inadvertently losing data results which could otherwise be saved in a file for future use or use by another program. The existence of unsaved calculated and/or imported values is indicated in the window caption with an asterisk (*) in the same fashion as changed user entry values. In the case of SIGNAL2000, the protected values are the calculated SATURATIONFLOWS and/or optimized CYCLES, GREENTIMES, YELLOWTIMES, CRITICALS and/or SEQUENCES. A similar message is now issued when File-Open or Reset [Parameters] is used when edited, calculated and/or imported values have not been saved.

>Edit Window Contents Can Be Printed, Including Line Numbers.

The contents of the TED Edit window, either within TED or the built-in edit window in any TEAPAC program, can now be printed using the normal print menu or toolbar buttons, including line numbers.

>Global Entry of Additional Sequence Codes Now Includes All Extra Codes.

The entry of additional sequence codes for intersection 0 (to be assigned to all intersections) has been expanded so that all extra sequence codes will be assigned to all intersections, not just the first extra sequence code. This allows added flexibility when using this global entry feature for SEQUENCES.

>VOLADDITIONALS Values Now Allowed to be Negative.

The entry or computed values for VOLADDITIONALS is now allowed to have negative values, with a complete input range permitted from -9999 to 9999. This is primarily to afford the possibility of re-assignments of traffic to result in a net reduction of volume for individual movements, either by manual entry or computations from SITE. In the case of SITE, this also means that ROUNDing of results can create small negative VOLADDITIONALS in locations that receive little or no new traffic and where final volumes are rounded down (this is appropriate and to be expected).

>LinkTo followed by Another LinkTo Performs Properly.

Multiple LinkTo operations can now be performed smoothly under all conditions without limitation. Previously it was observed that under certain conditions, one LinkTo followed by another LinkTo could cause certain problems successfully connecting to the next desired program.

>Better Graphics for Phasing Display and Bitmap Buttons.

The arrows used to represent phasing in various dialogs have been improved in quality and appearance, and if timings for phasings are defined by-movement instead of by-phase, the by-movement phasing diagrams are now shown in every relevant dialog. In addition, the pan and zoom button bitmaps within the View-Network display have been improved for better clarity.

>Option to Select Pages to Print; Page 0 for Current Page.

An option has been added to the Print-Setup dialog which allows the selection of specific pages to be printed instead of always printing all pages in the output window. Selection of page 0 will print only the current output page (the page which contains the insertion point cursor).

>View-Network Works Without Defined Network Distances.

Previously it was not possible to perform the View-Network function unless all NETWORK distances had been entered. This was due to the function's attempt to establish a scale factor between the network distances entered and the potentially arbitrary coordinate system used. Now, if distances are not entered, View-Network simply assumes the scale factor is 1.

>Warnings Issued If Too Many Characters Entered or Number Too Large in an Input Field.

If a user enters more characters in a dialog's input field than the dialog expects or can process, a warning is now issued and the entire entry is ignored, rather than just ignoring the extra characters. This allows for better understanding by the user that the entry may not have been processed correctly. The F5 Refresh button should be used in all cases to see the current dialog values after the warning. On a similar note, if an entry has a numeric value too large for the intended internal variable, this condition is also noted with a message rather than allowing the possibility of a more catastrophic reaction by the program at a later point.

:SIGNAL2000 Ver 2.60 08SEP04

Build 06 - 22SEP04

>Summary of TEAPAC2004 Release of SIGNAL2000.

After 2 years in development, the TEAPAC2004 version of SIGNAL2000 has been released as Ver 2.60. The highlights of the changes since its prior release include the following:

Completely seamless, one-click, one-file exchange of all input and results with all PRE-processors, SITE, TURNS and WARRANTS, including calculations of HCM satflows, optimized timings, peak-period turn counts and estimated site traffic.

New volume adjustment inputs to allow factoring volumes and adding additional volumes on a movement-by-movement basis.

New sensitivity controls for global testing of factored volumes, additive volumes, factored satflows, minimums, clearances, etc.

Complete implementation of the enhanced TEAPAC2004 (Ver 6) user interface, as described below.

>New Volume Adjustment Inputs Provide Sensitivity Analysis Flexibility.

A new input called VOLFACTORS has been added that allows a volume adjustment factor to be provided for each individual movement of each intersection. Each volume entry is multiplied by this factor, with the option of further providing a number of years the factor should first be compounded. This feature provides the ability to easily test various traffic growth factor scenarios, as well as sensitivity analysis for the base volume entry.

Another new input called VOLADDITIONALS has been added that allows a volume adjustment value to be provided for each individual movement of each intersection. Each volume entry is adjusted by adding this additional volume, with the option of further providing a single factor for each intersection which is first multiplied by the additional volume before the it is added to the base volume. This feature provides the ability to test additive growth scenarios, in addition to the factored growth scenarios allowed by VOLFACTORS above, such as when evaluating site traffic development scenarios. The VOLADDITIONALS factor can also be used to easily 'turn off' the additional volume by using a factor of zero, and 'turn back on' the additional volumes. VOLADDITIONALS are computed directly by SITE for site traffic impact scenarios and saved in data files for immediate analysis and optimization by SIGNAL2000.

>Minor Organizational and Usability Changes.

MINIMUMS and REQCLEARANCES have been added to the [BASIC] menu and group definition for quicker accessibility, since these are common inputs required for realistic optimization. The INTERSECTION dialog has also been removed from the [APPROACH], [MOVEMENT] and [PHASING] menu/group definitions -- they were originally added to these menus/groups for better awareness of the current intersection in the Tabular View, but the current intersection is now listed in the caption of the Tabular View.

>T2004v6: TEAPAC2004 Interface Enhancements Found In All Programs.

TEAPAC2004 (Ver 6) includes a multitude of enhancements which are part of the generic user interface found in all TEAPAC programs (some do not apply to NOSTOP, TED or TUTOR, for readily-apparent reasons). All of the generic enhancements are listed below with heading lines that begin with T2004v6:.

>T2004v6: One Common Data File Supports All TEAPAC Programs.

The most significant and obvious change made to each TEAPAC program in Version 6 is that all programs now share a single, common data file structure that contains all of the data entries used by all TEAPAC programs. This means that any TEAPAC program (except NOSTOP and TUTOR) can open any file from any other TEAPAC program, make changes to any of the data values it contains, and re-Save the file with complete retention of all data values for future use by any other TEAPAC program.

The first implication of this major fundamental change is that the concept of File-OpenShare of earlier TEAPAC programs is no longer needed since the sharing of TEAPAC files among TEAPAC programs is now fundamental and automatic. File-OpenShare has been re-named to File-OpenMerge/Share to better reflect its current function, to merge the content of multiple files, and can still be used to read and merge the content of files from older versions of SIGNAL97, SIGNAL2000 (Ver 1), SITE, TURNS and WARRANTS -- OpenMerge is automatic when reading these files. Also, the warning message when saving to a file created by one of these other programs has been removed, again because this function is now standard procedure and has no risk of loss of data.

The second implication of this change is that any values computed by one program and to be used by another (such as peak-period volumes from TURNS, HCM satflows from SIGNAL2000, optimized signal timings and phasings from SIGNAL2000, projected traffic from SITE, etc.) need only be saved into the data file with File-Save, then the next program launched with the same file using the LinkTo menu. A single click positions the user in the next program ready to do the analysis of that program.

Lastly, all programs (except NOSTOP and TUTOR) now have the ability to store all of this data for up to 500 intersections in a single file.

>T2004v6: LinkTo Menu In All TEAPAC Programs Includes All TEAPAC Programs.

All TEAPAC programs (except NOSTOP and TUTOR) now contain the LinkTo menu which now provides immediate access to all other TEAPAC programs with a single click which causes the current data file to be re-opened in that program.

>T2004v6: LinkTo Function Now Allows Direct Link to Host Programs.

A new function of the LinkTo menu has been added which allows direct linkage to the six host programs which are supported by the six TEAPAC preprocessors. These are PRETRANSYT for TRANSYT, PREPASSR for PASSER, PRENETSIM for CORSIM, PRESYNCHRO for

Synchro/SimTraffic, PRETSPPD for TS-PP/Draft, and now PRENOSTOP for NOSTOP. Since all programs have access to the control directives for all the preprocessors, this means, for example, that a TRANSYT run can be made directly from SIGNAL2000 with a LinkTo-TRANSYT (assuming a licensed copy of PRETRANSYT is installed on the system).

>T2004v6: Global Input Option for Most Intersection Inputs.

A powerful new feature has been added to all TEAPAC programs that allows the value of a single data entry to be made to all intersections in the NODELIST (or the SUBSYSTEM, if one is defined). This is done when Intersection 0 is selected, and the user is first warned of the pending global entry action and followed by an audible beep when the global entry is made. The warning message can be omitted for future such actions, if desired.

Examples of uses for this new feature include the following: Enter a common cycle length or cycle range for SIGNAL2000 optimization of all signals; designate a full SIGNAL2000 phasing optimization for all signals; set the new volume adjustment factor or number of years for compounding a growth factor for all intersections for sensitivity analysis; enable or disable the new additional volumes entry for all intersections; designate a common peak hour factor for specific movements or all movements of all intersections; set the minimum or required clearance values for optimization at all signals; set the satflow adjustment factor for all signals to perform sensitivity analysis; etc. The possibilities of this new feature are virtually endless.

>T2004v6: View-Network Function Improved with Easier Pan & New Zoom.

The View-Network function has been added to all programs (except NOSTOP and TUTOR), and has been greatly improved in functionality regarding the ability to pan up/down and left/right, as well as new functions for zoom in/out and selecting a view area of the network connections and underlying bitmap with the mouse.

>T2004v6: Output/Edit Window Major Enhancements.

The Output and Edit Windows have been enhanced with menus and toolbar buttons which provide the ability to Find a user-entered text string, find the next output report and find the next page of results. A button also allows moving backwards thru the output to the previous output page. In the Edit Window, an additional Find & Replace function has also been provided. Also, the current line number of the cursor is displayed in the status line of the window, and the ^A function now performs the standard 'SelectAll' function instead of copying the entire window to the clipboard.

>T2004v6: Toolbar Button Provided for Intersection Selection.

A toolbar button has been provided in the main window next to the +/- buttons which provides direct access to the Intersection dialog to select the 'current' intersection, allowing quick access to this common function without the need to use the menus.

>T2004v6: Intersection/Type Description Listed in Dialog Caption.

If an intersection description has been provided for the current intersection (via the Intersection dialog), this description is displayed in the caption of any intersection data dialog in addition to the intersection number. For traffic impact studies with SITE, the same function is true for the current distribution type. These number and description displays are now also included in the caption of the Tabular View window.

>T2004v6: Check For Internet Update Function Provided.

A new function has been provided in the Help menu of every TEAPAC program that allows the user to have the program check the internet for any available downloadable updates. This function can be set to automatically check for updates every time the program is launched. If updates are found, this fact is displayed along with the status of the update (free or if a fee is involved and what that fee is), as well as a link to a complete description of what functionality changes the update includes, the ability to launch an email requesting a new key for a paid update or a quote for an upgrade. Options to view a complete price list online, to launch an email requesting technical support, and to go to the Strong Concepts main web page are also provided. This feature was partially implemented in the most recent downloads of several TEAPAC programs and accepted with great enthusiasm.

>T2004v6: INTERSECTION Dialog Includes Option to Renumber a Node and All Refs.

The INTERSECTION dialog now contains a feature to renumber any intersection in the NODELIST to any value not currently in the NODELIST. When selected, all references to the old node number anywhere else in the network are also updated, making renumbering a snap.

>T2004v6: Save Remembers Selected Intersection/Type for Subsequent Open.

When data files are saved, a directive is placed at the end of the file which remembers the 'current' intersection and current distribution type so that these positions can be reset when the file is subsequently re-opened by either the same program or any other TEAPAC program.

>T2004v6: Error Message Help Leaves Dialogs Open so Errant Entries Can Be Seen.

When Help for an error or warning message is displayed, the dialog entry which caused the error or warning is now left open so the entered values can be inspected in relation to the help advise given. Also, a note is provided in the message to use the Refresh button to see the dialog with the actual current values which are likely to not reflect the entry attempted (which caused the error or warning).

>T2004v6: Errors Contain Cancel Button to Abort File-Open or Control File.

When errors or warnings are issued as a result of reading a data file, a Cancel button is now provided which allows the user to abort continued attempts to read the file. This is now a convenient way to halt attempted processing of a file which is clearly not what was intended, or for power users, a way to kill a control file which has gone off the deep end.

>T2004v6: OUTPUT Dialog Contains Entries for All Programs.

The OUTPUT dialog is a common dialog name which has had different content for most TEAPAC programs. This conflict and impediment for combining all the TEAPAC data into a single file for TEAPAC2004 has been resolved by having a common OUTPUT dialog for all programs which contains the OUTPUT parameters for all TEAPAC programs. In the manual mode and control files, this involves the addition of a new parameter #1 which is the name of the program for which the following values apply, and thus all OUTPUT parameters for all programs are stored in the file and displayed in the dialog.

>T2004v6: Wording on Dialogs Used by Multiple Programs Improved.

The wording on dialogs which are used by multiple programs in TEAPAC2004 have been clarified so that it is more apparent what the relevance is to the current program in which the dialog is found.

>T2004v6: NODELIST Entry Protected from Change in Tabular View.

The only safe place to change the NODELIST after it has been entered is in the Normal View NODELIST dialog, so the NODELIST entry in the Tabular View has been greyed and protected from change to avoid unintended changes and possible disastrous results.

>T2004v6: Options-Setup Uses Browse for Folder, not Browse for File.

The Browse button in the Options-Setup dialog now produces a Browse-for-Folder dialog instead of the File-Open dialog so it is more clear what the function will return.

>T2004v6: Dialog Actions Re. ROUTEs with 9+ Nodes Fixed, Including Save.

Certain problems with ROUTES which contained more than 8 nodes have been fixed, including saving these route definitions.

>T2004v6: Recent File Menu Option Works Under All Windows Platforms.

Display of recently used files in the File menu has presented problems under certain Windows platforms, and thus an option has been provided to turn this display off so recent files are accessed only thru the File-RecentFiles dialog. This problem has been fixed so recent files can be displayed in the File menu on any Windows platform, and thus the default condition for this feature has been changed from No to Yes.

>T2004v6: Command-Line Control File Enhancements.

When a user has set a TEAPAC program to start in the Tabular View, ASK commands in command-line control files could not be used. This limitation has been eliminated so this feature can be used, if desired.

The output window for output generated by a command-line control file now appears in front of the main window so it is immediately visible without the need to click it to bring it to the front.

A new /x option has been added at the end of a command-line file name which instructs the program to open the command-line file as File #x (the default is File #1, as before). This allows the data file which a control file #2-5 opens to be designated as File #1 so that it is the file which will be open for subsequent File-Save operations from the File menu. Opening command-line control files as #2-5 instead of #1 is now the recommended practice.

>T2004v6: -X Entry for INTERSECTION Number Allowed As Positional Input.

The intersection number on an INTERSECTION command line or dialog is now allowed to be a negative number between -1 and -N where N is the number of intersections in the NODELIST. When this is the case, the intersection selected is the i-th node of the NODELIST when -i is used. The expected use of this feature is to allow REPEAT loops in control files to easily sequence through all the nodes of the NODELIST when the NODELIST is not in numerical order and/or not a sequential list of nodes from 1 to N.

>T2004v6: TEAPAC Menu Enhancements.

A new File menu in the TEAPAC Menu shows recent files which have been used by the program; a new Options menu allows program folder setup for all of the third-party programs supported by the Menu; a new Help menu can list recently installed changes and check the internet for updates; default support for VISSIM 4 and TRANSYT-7F Release 10 is provided.

TEAPAC files which are double-clicked to be launched thru the TEAPAC Menu now open into the menu only without launching the program that created the file (since any file can now be used by any program, this old action is no longer appropriate).

>T2004v6: Printable On-screen Manuals Available as PDF Downloads.

The full documentation for each TEAPAC program has always been directly available as the on-screen manual which also serves as the context-sensitive Help document. Options for obtaining printed/bound copies of this document have also been available at an additional cost. Now, in addition, this document is available as a downloadable PDF file which provides the ability to print a copy locally, as well as search the entire document for user-defined strings.

:SIGNAL2000 Ver 2.02 22NOV03

Build 16 - 16JUL04

>More Flexibility Added for Lost Time Calculation in Protected-Permitted LT.

SIGNAL2000 has been enhanced to provide the ability to have different lost time values calculated for the protected and permitted portions of compound left turns. In prior versions, a single lost time value was calculated for each movement of an intersection. Now, if Yellow+AllRed clearance times are different for the protected and permitted phases of a protected-permitted or permitted-protected left turn, the computed lost times for these two conditions will be different, better reflecting the different behaviors these phases might experience.

>Fix for >100 Nodes in NODELIST and SUBSYSTEM Dialogs of 500 Node Version.

A problem has been fixed which could cause difficulties displaying a node list with more than 100 nodes in the NODELIST and SUBSYSTEM dialogs of the 500-node version of the program.

>Automatic Check for Updates Added When Connected to Internet.

A new feature has been added which allows an automatic check for updates via the internet any time the program is started when an internet connection is present. The automatic check can be disabled from the Help menu using the CheckForUpdates option. The same menu selectiion can be used to manually check for updates, to review details about any available updates, to download updates, to see update prices (if they are not free), to request a quote for updates and to order certain updates.

>Accelerator Key Definitions Added to Tooltip Help for Dialog Buttons.

Tooltip help strings for certain dialog box buttons have been updated to include the accelerator keys which can be used in lieu of the buttons.

Build 14 - 29MAR04

>Installation Setup Modified for Proper Creation of Shortcuts.

A change has been made to the configuration of the new MSI installation setup now used by most TEAPAC programs. Now when shortcuts are created in the start menu or the desktop during installation, they are configured properly with the installation folder set as the 'Start In' folder (Working Directory) for the shortcut. In recent TEAPAC releases which use the new MSI installation system, this configuration option was not selected, resulting in a possible problem when running the program in Exporting to HCS and locating the Help file (on-screen manual,

Help-Contents menu, Help buttons and F1 key) and/or the Recent Changes file (Help-RecentChanges menu).

Build 12 - 03MAR04

>Prot-Perm LT Flags More Reliable for Analyze.

A more reliable means of determining some of the complex protected-permitted relationships in the HCM was implemented in the initial release of SIGNAL2000 Ver 2 for the DESIGN optimization aspect of the program. These new methods have performed well under the challenging conditions of constantly changing timings during optimization, and thus have now been implemented in the capacity-analysis-based ANALYZE aspect of the program so that consistent results will be obtained under all conditions from both aspects of the program.

The primary potential impact that this change might have on a user is that the HCM definition of phase adjacency for protected-permitted (compound) left turns may be applied differently now for capacity-analysis-only functions than in previous capacity-analysis-only analyses. This could result in different lost times for compound left turn movements, and thus different delay values under these limited conditions. Capacity analyses of optimized conditions which immediately follow use of the DESIGN function will not change.

>Prevent Division by Zero and Overflow Errors for Unusual Cases.

Certain unusual cases which can produce overflow and/or division by zero results which crash the program have been added to the data contingency checks of the program to prevent future crashes under these conditions. For example, optimization under certain conditions can create very small g/C values which cause problems when calculating the Fmin value of the permitted left turn Flt calculations. Now the Fmin calculation has the same limit applied as the Fm calculation to prevent this from being a problem during optimization. Another example is when a significantly over-saturated analysis is performed, the aproach and intersection total delay values might overflow, causing similar crash potential for the Evaluate function. Lastly, if certain inadequate signal timings have been entered for a capacity analysis, division by zero can result in the attempt to verify the inputs. All of these conditions are now detected before they occur so that a less catastrophic message can be issued, as necessary, and the analysis can proceed without interruption.

>Further Enhancements to Ver 5.12 Interface.

The Ver 5.12 TEAPAC interface found in most TEAPAC programs has been further refined with additional features to aid in the analysis process. These include: 1) saving the current intersection in the data file so that when the file is re-opened, the same current intersection is re-established (rather than always being pointed to the last intersection in the Nodelist), 2) providing the ability to scale a bitmap background for a single intersection analysis by right-clicking on a point 100 feet from the intersection, and 3) providing a Clear button on the Subsytem and Route dialogs so that the lists displayed can be removed with a single click.

Build 10 - 31DEC03

>Further Enhancements to Ver 5.1x Interface.

If a NODELIST entry is read from a Shared file, the new NODELIST is appended to the current NODELIST instead of replacing it. This effectively allows the merging of separate data files to create a larger system. Caution must be used when one file is already open in a program and another file is opened that was not created by the current program, since this file will automatically be Open-Shared, and thus appended if it has a different NODELIST.

If an INTERSECTION entry is read from a Shared file and is not in the current NODELIST, it is automatically appended to the end of the NODELIST. As with NODELIST above, this makes the Shared function effectively an automatic Merge function.

Duplicate nodes encountered in a NODELIST entry or an appended NODELIST are ignored.

The File-OpenShared menu item has been changed to File-OpenMerge/Shared to better indicate the fuction which this type of Open normally performs.

When a LinkTo function prompts the user to save changed data before the LinkTo is performed and a new path/file name is given, this path/file name is used by the LinkTo function. If no file has been provided, the LinkTo function performs properly with a linkage to the next rpogram, but without any data transfer.

>Pending New PRENOSTOP Program Added to LinkTo Menu.

A pending new TEAPAC program call PRENOSTOP which interfaces the NOSTOP program to the data of other TEAPAC programs such as this program and SIGNAL2000 has been added to the LinkTo menu.

:SIGNAL2000 Ver 2.01 02FEB03

Build 54 - 05JUN03

>Lost Times Re-calculated After Design for Each DESIGN N Capacity Analysis.

Lost times are now re-calculated before each capacity analysis which is performed as part of a DESIGN N analysis. This accounts for those occasions where various phasing being considered by DESIGN cause different lost time calculations, the last of which might not be correct for subsequent capacity analyses which are performed as part of a DESIGN N analysis. This guarantees the same, correct lost times are used for capacity analyses produced by either the ANALYZE or DESIGN N functions.

Build 52 - 04JUN03

>Convert ByPhase to ByMov Uses Reqclearances to Maintain Individual Y+AR.

The Convert button on the GRTEENTIMES and YELLOWTIMES dialogs has been modified so that when ByPhase timings are converted to ByMovement, the REQCLEARANCES values for each movement are used to define the ByMovement clearances rather than using the ByPhase phase clearances. This permits individual movements to maintain distinctly different clearance times, regardless of how many timnes the Convert button is used. To this end, entries of ByMovement clearance times in the YELLOWTIMES dialog are always transferred directly to the REQCLEARANCES dialog, and REQCLEARANCES entries are transferred directly to the YELLOWTIMES dialog if timings are ByMovement.

Build 50 - 08MAY03

>Expanded Seamless LinkTo Menu Includes New PRESYNCHRO and PRETSPPD.

With the addition of the PRESYNCHRO and PRETSPPD programs to the TEAPAC family of seamlessly integrated programs, these two programs have been added to the LinkTo menu which allows one-click transfer of data and control to these programs, as well as to the original PRETRANSYT, PREPASSR and PRENETSIM programs.

>Pedestrian Phase Displays Divider Line In Output Reports.

When displaying a phasing which includes an exclusive pedestrian phasse in various output reports such as the Capacity Analysis Summary, the position of the ped phase is noted by showing the word PEDPHASE in the vertical divider line which separates the two vehicle phases which surround the exclusive ped phase. In addition, the existence of the ped phase is accounted for when calculating offsets for every phase displayed.

>Old Format System Cycles Read from PRETRANSYT, PREPASSR and PRENETSIM Files.

If a 'system cycle length' is read from an old-style data file from PRETRANSYT, PREPASSR or PRENETSIM, this old-styled definition is accommodated by assigning this system cycle to each intersection defined in the NODELIST read from the file.

>Faster Output Window Update.

The display speed for large amounts of information in the Output Window has been substantially increased so that an inordinate amount of time is not spent when many capacity analyses, optimizations or data summaries are produced in a single output window.

>Sample Bitmap Background Provided with Sample Data File.

An example bitmap background is supplied with the sample data file SIGNAL20.FOR for display with the View-Network menu option.

:SIGNAL2000 Ver 2.00 30NOV02

Build 10 - 30NOV02

>Analyze or Optimize up to 500 Intersections with a Single Click.

SIGNAL2000 now has the same data structure as PRENETSIM, PRETRANSYT and PREPASSR, in that multiple intersections can be entered and stored in a single data file. The list of intersections is managed with a new NODELIST entry which lists all the available intersection numbers which have been used, and the INTERSECTION entry which selects the 'current' intersection from the NODELIST. The current intersection is the one for which data entry will be accepted and for which analysis functions like DESIGN and ANALYZE will be made. The current intersection can be selected by using the drop down list in the INTERSECTION dialog again, or by 'walking' through the NODELIST with the +/- buttons found on the main toolbar and relevant entry dialogs. The current intersection is displayed in the status bar at the bottom of the main window. Intersection numbers can now range from 1 to 999.

New intersections can be added to the network by first adding it with the NODELIST dialog, then selecting it from the INTERSECTION drop-down list (or typing it in the INTERSECTION combo box). As a shortcut, the new intersection number can be typed (with a description) in the INTERSECTION combo box, in which case the user will be prompted with an option to add the intersection to the end of the NODELIST automatically.

INTERSECTION 0 is a selection which represents all intersections in the NODELIST. When this is selected, certain actions like ANALYZE and DESIGN 1 will be performed for all intersections. Certain other actions like SORT, TIMINGS and EXPORT are not valid when INTERSECTION 0 is selected, as these actions can pertain to only a single intersection.

Usage Level 1 of SIGNAL2000 will only perform a capacity analysis for a single intersection. Usage Level 2+ of SIGNAL2000 includes the optimization feature. Usage Level 2 handles up to 12 intersections, Usage Level 3 is up to 100, and Usage Level 4 is up to 500.

>Additional System Commands Help Manage Multiple Intersection Activities.

Several additional entries have been created in SIGNAL2000, as found in the TEAPAC preprocessors, which assist in managing the activities which surround multi-intersection analyses. In Usage Level 3 and above, the SUBSYSTEM entry can be used to select a group of intersections which is a subset of the NODELIST for subsequent analysis when INTERSECTION 0 is selected. A ROUTE entry can also be used to define up to 8 predefined subsets, usually, but not limited to arterial routes, which can then be used as shortcuts in the SUBSYSTEM entry by entering the negative route number.

>Combine Prior SIGNAL2000 Files into a Single Data File.

Since prior versions of SIGNAL2000 (and SIGNAL97, SIGNAL94, etc.) only handled one intersection in each data file, it will be desirable to merge all of these files into a single file in SIGNAL2000 Version 2. This can be done quite easily by opening each prior file using the File-OpenShared menu, as long as each of the intersections loaded used a different intersection number or no number at all (in which case you will be prompted to enter a number). The list of intersection numbers to be used can be entered in the NODELIST in advance of the OpenShared, or the user will be prompted to automatically add each intersection number to the end of the NODELIST as new numbers are encountered. When all intersections have been loaded, use File-SaveAs to save the single combined file into a new file name. If OpenShared is not used, the possibility of losing all data previously entered into Version 2 exists due to the way the older versions initialized the older programs; if Version 1 files are being Opened, this condition is detectable and a warning is issued to that effect.

>Explicit Ability to Represent Nema-style Controllers.

When entering or viewing controller timings, a new Convert button appears on the GREENTIMES and YELLOWTIMES dialogs which allows the user to select the style of entry or view, either 'By Phase' which is the traditional HCM method, or 'By Movement' which is more similar to the way timings are used on NEMA and other dual-ring controllers. If any timings are present, they will be converted to the other format at the same time, including YELLOWTIMES if the GREENTIMES dialog is displayed, and vice versa. When timings are Converted, the conversion will also include reviewing the allowed SEQUENCES list and moving the appropriate sequence code to the top of the list according to the timings present.

Allowing timings 'By Movement' makes it apparent that for certain overlap phases, phase lengths which are apparently negative in the 'By Phase' method are, in fact, perfectly valid timings for dual-ring controllers, as long as the negative value of the overlap phase greentime does not exceed the yellowtime of that same phase. This permits a wider range of timings to be represented by the traditional 'By Phase' (HCM) methodology, and this extension is now also permitted by the optimization method of the DESIGN command. 'By Movement' timings are not allowed when special phasings represented by negative SEQUENCE codes are used.

>Easy Entry of Multiple Phasing Possibilities for Optimization.

NEMA-style, dual-ring controllers inherently support multiple phasings from the perspective of the traditional 'By Phase' approach of representing signal operations. This means a typical dual-ring SEQUENCE list might look like, for example 14 15 16, to indicate that the north-south phasing is single phase (1), but that the dual-ring controller can handle any protected left turn phasings (4), including overlaps (5 & 6). Shorthand codes A, B, C and D have been created for representing these typical permitted lists of SEQUENCE codes, as follows:

A represents codes 1-8. This is all possible phasings.

B represents codes 1-6. Left turn protection with option for no LT phase.
C represents codes 4-6. Left turn protection requiring a LT phase for all lefts.
D represents codes 7-8. Left turn protection using Lead-Lag/Split-phase phasing.

Thus, the example list above (14 15 16) can be entered simply as 1C, a list like 11 12 13 14 15 16 can be entered as 1B, and all codes can be entered as AA (ALL is still allowed).

>Definition of Up to 9 Special Phasings Allowed.

Prior versions of SIGNAL allowed special phasings to be defined for ANALYZE, etc. (but not DESIGN) by referencing SEQUENCE code 0 and then using PHASEMOVEMENTS. For compatibility with PRETRANSYT, etc. SEQUENCE codes -1 to -5 were also allowed. Now that multiple intersections in the system may require special phasing descriptions, the negative notation is a requirement in SIGNAL2000. The number of special phasings has been increased to nine through use of the SEQUENCE codes -1 to -9.

>Seamless Integration with PREPASSR, PRETRANSYT and PRENETSIM.

A new LinkTo menu has been created that allows immediate transfer of control to the TEAPAC preprocessors PRENETSIM, PRETRANSYT and PREPASSR. This transfer of control includes closing the current data file, with a prompt to save unsaved data, and passing that file to the new program. This permits immediate use of the preprocessor functions with virtually no overhead of collecting the necessary SIGNAL2000 files for use by the preprocessor. This is due primarily to the new multi-intersection feature added to SIGNAL2000, and the presence in SIGNAL2000 of all of the system control information which the preprocessors require (like OPTIMIZE, SIMULATION, etc.). The file opened in the preprocessor will be OpenShared automatically and should not be saved into by the preprocessor, as such a save will lose much of the intersection detail SIGNAL2000 placed in the file and the preprocessor has ignored. A warning message to this effect is issued by the preprocessor if a save is attempted.

>Vastly Enhanced Optimization Features.

The biggest change in the optimization by SIGNAL2000 is via the new entries which are possible in the LEVELOFSERVICE command. In prior versions, the first entry of LEVELOFSERVICE was the target level of service desired for critical movements, and the second entry was basically ignored by DESIGN. Now the LEVELOFSERVICE entry contains two sets of three entries, the first set for delay targets and the second set for v/c targets, as follows:

<target delay>	the desired amount of delay for all critical movements
<max delay>	the max amount of delay for critical movm'ts before switching to v/c
<delay increment>	the increment of delay used to move from target to maximum
<target v/c>	the target amount of v/c (%) for all critical movements
<max v/c>	the max amount of v/c (%) for critical movements before giving up
<v/c increment>	the increment of v/c (%) used to move from target to maximum

The optimization will first attempt to balance the delay of the critical movements at the target delay value. If this is possible, any excess time will be allocated proportionally to phases which support the priority movements defined on the EXCESS entry (or all phases if no EXCESS is defined). If the target cannot be reached, repeated attempts will be made to balance delay at subsequent delay values using the delay increment provided. If the maximum delay is reached without a solution, the optimization moves to the v/c targets provided with the same incremental process. If the maximum v/c cannot be satisfied, then a 'Saturated' solution (LOS S) is forced using the last v/c target attempt as a starting point. LOS letters are still accepted for the first two delay entries.

This new strategy accomplishes several important benefits. 1) Any delay target can be specified, not just a delay value that defines a LOS boundary (eg, 35, 55 and 80 for LOS C, D and E). 2) A delay target greater than 80 (LOS E boundary) can be specified, if this is a desired objective. 3) When a given target is not attained, the smaller allowed increment of delay between LOS boundaries permits much better balancing of delay levels when these critical delays are not close to an LOS boundary. 4) A specific v/c target can be selected, rather than just 100%.

The SORT results have been modified to reflect these changes: a new column has been added to show the actual delay or v/c target which was used when a solution was reached (not just the LOS achieved). The LOS is still listed, but the list is further sorted by the target achieved, which does a beter job of ranking the optimized phasings and reflecting the quality of performance each phasing solution will produce.

If it is desired to skip the delay target process completely and perform only v/c balancing, this can be accomplished by setting the delay target to zero. Likewise, if it is desired to skip the v/c balancing after the delay targets are not met (thus forcing a solution based on the last delay target), this can be accomplished by setting the v/c target to zero.

>Calculation and Reporting of Minimum Cycle Length which is Never Violated.

A new column has been placed in the SORT results which displays the minimum cycle length for the phasing and movement minimums specified. If the cycles tested do not reach this cycle, the LOS displayed in the DESIGN and SORT reports is M and no solution is produced, now guaranteeing that minimums are never violated by any solution produced by the optimization. This is in contrast to the previous method which did not distinguish between a 'Forced' solution due to oversaturation and one due to minimum cycle constraints.

>Improved Optimization of Cycle Length for All Cycles which Yield the Same LOS.

When several cycles produce the same critical LOS, prior versions of SIGNAL simply picked the lowest cycle, since in the eyes of the HCM the results were indistinguishable (all the same LOS) and the lowest cycle was likely to produce the shortest queues. Now in this case the cycle which produces the least critical delay (within the accuracy of the optimization delay increment) will be

selected. This typically results in a capacity analysis which reflects slightly less critical delay than the cycle previously selected.

>Improved Optimization for Priority and Critical Right Turns.

An improvement has been made to the way critical right turns are handled, as well as when they appear in the EXCESS list of priority movements. Now, additional time is only allocated to the through phase for the right turn, instead of all the RT phases.

>Improved Optimization and Reporting when Minimums Control the Optimization.

When a phase time is controlled by a minimum, a tricky situation exists in the optimization process when an initial assessment is made as to how much time each phase requires for a certain critical target, and then excess time is allocated to phases for priority movements which include this phase (or no priority movements have been defined). The problem is that the initial phase time for the phase already includes the minimum, so it is this time that is expanded, not the time required to meet the target. However, if the initial phase time used is for the target, the expanded phase time may not meet the minimum. This becomes a circular problem, but one that has been solved by a clever bit of iterative optimization that makes sure the minimums are met, but expands the time required for the target if possible. The net result is that in many such cases, the phase controlled by the minimum will remain controlled by the minimum, instead of getting additional time from the EXCESS process, thus making more time available for other priority critical movements and resulting in overall improvement in performance. As a byproduct of this new method, the phasing diagram in any optimized capacity analysis will display an 'M' in the lower left corner of a phase which is still controlled by a minimum in the final optimized timings.

>Option to Report Critical Delay and/or v/c Achieved by DESIGN for Every Cycle.

A new option in the OUTPUT dialog has been added that allows a more detailed report after a DESIGN which shows the critical movement delay or v/c target which has been achieved for every cycle/sequence combination optimized. This permits a more detailed assessment on the effect that cycle length has on the critical target (delay or v/c) than allowed by the normal DESIGN result, since that table only has room to report the critical LOS for each combination.

>Improved Modeling Issues for Optimization.

A change in the iterative DESIGN optimization now makes the definition of Protected-Permitted adjacency during optimization more consistent with the proper definition which is used when performing a capacity analysis. This results in a more consistent comparison between the DESIGN result and a capacity analysis when this situation controls the DESIGN. This was particularly apparent in situation where an optimum overlap time was zero, which now makes the phases 'adjacent' during optimization, where it wasn't considered adjacent before.

>View-Network Menu Added to Display Connected Intersection Network.

This new menu selection permits viewing the interconnections between intersections which have been defined by the multi-intersection inputs to the program, particularly in relation to entries which have been made in the NETWORK dialogs. The graphical display shows all of the relationships between intersections which have been established in a proportional diagram layout that can be scrolled across the entire network area. If desired, a bitmap of an aerial photograph or map of the study area can be defined as a background for this display to show the study network in relation to the information reflected by that background. The bitmap should be stored in the same folder as the associated data file, and should have the same name as the data file, but with a .BMP extension.

>Optimized Phasing is Selected Automatically for Subsequent Capacity Analysis.

When the TIMINGS command is used to review the timings optimized by DESIGN for a specific SEQUENCE code, this SEQUENCE code is automatically placed at the top of the list of allowed SEQUENCES so it will be the SEQUENCE used by a subsequent ANALYZE, EVALUATE, QUEUECALCS, EXPORT, etc. The dialogs related to these actions no longer accept the entry of a sequence code due to this change, making it much easier to move from DESIGN to ANALYZE for various sequence codes and without the possibility of performing inappropriate and incompatible actions by each.

>Phasing Diagrams in Dialogs use Better Arrow Representations of Movements.

Arrows shown in dialog boxes depicting turning movements have been improved in design so they are easier on the eye and more clearly depict the movement intended. In addition, permitted movements in phasing diagrams in dialogs are depicted with dashed lines for added clarity. Also, arrows have been added to some dialogs for improved clarity.

>DESIGN Optimization Function can be Aborted Before it is Completed.

The Cancel button has been fixed in the DESIGN progress window allowing the DESIGN to be aborted before it is completed. Cases where this might be helpful include 1) when it is apparent that the results being generated are not adequate and changes need to be made, and there is no need to complete the DESIGN, 2) where the LEVELOFSERVICE controls have created a DESIGN with a time-consuming precision that is not necessary or appropriate, and need to be revised to start the DESIGN over, and 3) where DESIGN 1 for the entire network has been initiated and will take some time to complete, but a need for a change is observed in the progress output before it is completed.

>Miscellaneous Error Detection Improvements.

Several places where incomplete or grossly oversaturated conditions could cause division-by-zero crashes have been modified to detect the conditions before the crash and respond accordingly.

>Reorganization of Groups to Accommodate Multiple Intersections.

A new group of entries called [SYSTEM] has been added in the Edit menu to contain those command dialogs which are needed to manage multiple-intersection data inputs. These include the NODELIST, SUBSYSTEM, ROUTE, MASTERNODE and OPTIMIZE commands. QUEUEMODELS and SIMULATION have been moved to [SYSTEM] from the [INTERSECTION] group, and OUTPUT has been moved there from [TARGETS]. LEVELOFSERVICE and EXCESS have been moved from [TARGETS] to [INTERSECTION] and the [TARGETS] group has been deleted. The INTERSECTION command has been added to the [APPROACH], [MOVEMENTS] and [PHASING] groups, particularly for the Tabular View. The SUMMARISE output has also been updated to reflect similar organizational changes brought about by the new multi-intersection nature of the program, and most output reports have had the intersection number and description added at the top of the report, if not already included. Errors, warnings and progress messages have also had the intersection number added.

>Preview of Pending TEAPAC Interface Version 6 Changes (Interface Version 5.10).

A number of generic enhancements which will appear in all TEAPAC programs as TEAPAC Interface Version 6 are being previewed in SIGNAL2000 Version 2. Licensees of this version will be entitled to receive free updates to the Version 6 release when it is made official. These enhancements are described below:

>Output and Edit Window Management Changes.

The output window has been vastly enhanced with a number of important new features which the user will find helpful. These are: 1) The output window can be left open to accept additional subsequent output in situations where having all the output together in one place will make its assessment easier, such as multiple capacity analyses or optimizations listed in the same window for easier comparison and/or printing. 2) The maximum size of output held in the output window has been increased from a nominal amount to a virtually unlimited amount, limited only by available memory and to some extent processor speed. 3) Toolbar buttons and status-bar/tool-tip help has been added for all output window menu items. 4) The output generated by long calculations such as DESIGN or multi-intersection computations can be viewed progressively in the output window as they are generated, rather than needing to wait until they are all completed. 5) In control files, the HEADING -1 command can be used to force a display of results generated so far. 6) The output window is sizable and moveable, and the size and location is remembered throughout the remainder of the session. Most of these changes apply to the Edit window as well.

>Moveable Dialogs, Location Remembered.

All dialog boxes and message boxes are now moveable to any location on the screen, and the location is remembered for future dialogs throughout the remainder of the session. This allows

for custom organization of the user's desktop which matches the immediate needs of his/her analysis. This can be particularly helpful in highly multi-tasked environments, on ultra-high resolution screens, and on systems with dual monitors.

>New Refresh Button for Normal and Tabular Views of Visual Mode.

A new Refresh button has been placed on virtually every dialog box for the purpose of refreshing the dialog with the current values in each entry cell, in the event there is any confusion about whether a given entry has been accepted. This is particularly helpful after certain errors have been encountered or in a Tabular View display where one entry may change another entries values without changing the display (eg, when a WIDTH entry changes a LANES entry in a different place of the dialog). It can also be used to reset an action dialog's entries to the defaults after first being changed by the user.

>Warning of Possible Incompatible Advanced File Usage.

Advanced users of multiple files and/or multiple data sets in a single file are warned if a normal, simple Windows file command such as File-Save is used that appears inconsistent with the prior advanced file usage for the currently opened files. This is intended to prevent inadvertent saving of data on top of unintended places in advanced usage files.

>Help Available for Errors and Warnings from Manual Mode.

The Help button has been enabled in error and warning boxes which are issued as a result of actions initiated from the Manual Mode. Previously, these helps were not available.

:SIGNAL2000 Ver 1.11 02FEB02

Build 16 - 14JUL02

>Additional Checks Made for Lost Time Consistency.

Data input is now scanned to make sure that the Green+Yellow(+AllRed) times entered are compatible with the StartupLostTime and EndGain times entered, such that the resulting effective green times will be greater than zero. If this is not the case, an error message is issued and the analysis is cancelled to prevent erroneous results and possible division by zero crashes. This is particularly important when the resulting lost time is greater than the Yellow(+AllRed) time entered. Comparable checks are also made when an overlap phase time is zero, a condition which is permitted since, by definition, no movement sees the overlap time as the only phase time given.

>New Entries Allowed for Compatibility with PRETRANSYT, PRENETSIM and PREPASSR.

A number of new entries have been added which match those recently added to the PRETRANSYT, PRENETSIM and PREPASSR programs. These entries have no impact on the SIGNAL2000 calculations or results, but permit their entry with all other input data with SIGNAL2000 so the SIGNAL2000 files can be used directly by these other programs without modification. The input summary report has been updated to include the new entries.

GROUPTYPE can now be used to define lane groups which are sign-controlled. Permitted values now include Stop and Yield, which are control conditions which can be modelled by TRANSYT and CORSIM. If an intersection includes lane groups controlled by signs as defined by GROUPTYPES, SIGNAL2000 will process the information, but will skip any analysis of the intersection, with an advisory warning to this effect.

NETWORK has two new options added at the end of the entry, one to define the upstream-downstream assignment method to be used on links of a TRANSYT network, and the other to define the link curvature for CORSIM.

SIMULATION has four new options which define various parameters used by TRANSYT, CORSIM and PASSER.

Coordinate values entered via the NODELOCATION entry can now have a range of plus or minus 2,147,483,647 instead of the prior limited range of -9999 to 32,768. This greatly increases the flexibility and ease with which coordinate values can be derived and used.

>New Features for Export-Auto Host Definition and Launching.

The Options-Setup dialog now allows the name of the Host executable file to be added at the end of the Host path, in the event that this executable name is different than used by default. The dialog also displays the 64-char limit for path\file names which must be observed. When the AUTO option of Export is executed, the program will now first look for the designated Host program (either the default or specified name) and issue a message if it is not found, cancelling the Export.

>TEAPAC2000 Version 5.02 Generic Interface Fine-Tuning.

In the first release of the TEAPAC2000 Ver 5 Interface, users may have experienced difficulty using the Advanced Datafiles LOAD and SAVE functions from the Tabular View. These functions have been updated to work properly from the Tabular View.

Error messages generated from the Manual Mode, data files or control files will list the specific line of input which generated the error, with the offending item highlighted in red. If the information came from a file, the file number and line number of the error is also listed.

The File-New function has been updated to make sure that previous NETWORK entries are set back to default values, not just hidden. This assures that the old values do not unexpectedly appear later when an incomplete NETWORK entry is made.

Shortcut keys have been added to the File-RecentFiles and File-Save dialogs for more expediant keyboard manipulation.

Certain warning and error messages shouldn't be closed automatically by the new AutoClose option if these messages expect or require user response. The AutoClose option is now ignored for these cases.

The Help-Messages menu item has been changed to Help-RecentChanges to better reflect its purpose.

The Help-About menu item now shows the specific program name.

The default size of the Help window has been increased in size vertically to better display the contents of the complete, on-screen manual and context-sensitive help topics.

Build 00 - 02FEB02

>HCM Queue Model Changes Implemented.

The HCM Capacity Committee approved several changes to the HCM queue model that have been implemented in SIGNAL2000. Most notably, the method for handling unbalanced lane utilization has been improved from an approximation to a more precise calculation. Further, the original method allowed the calculation of an average lane queue, even when the saturation flow rate and delay calculations were based on unbalanced lane utilization -- this inconsistency has been removed. Lastly, the formula for the second term queue (Q2) was updated to include the effect that an initial queue has on this term.

The effect of these changes on SIGNAL2000 is felt in several areas. First, slightly different HCM queue calculations will be obtained by the ANALYZE, EVALUATE and QUEUECALCS functions when lane utilization factors less than 1.00 are used and/or when an initial queue is specified. Second, Models 2 and 5 (average lane queues) have been eliminated and Models 1 and 4 use whatever lane utilization factor was specified, creating the necessary consistency between the satflow, delay and queue calculations. Note that if the lane utilization factor used in the calculations is 1.00 the average lane delays and queues will be calculated, and if the lane utilization factor used is less than 1.00 the delays and queues will account for the unbalanced lane utilization (a worst lane analysis). If Model 2 is selected with QUEUEMODELS, Model 1 is used; if Model 5 is selected, Model 4 is used; and Models 2 and 5 no longer appear in the QUEUECALCS results.

>Queue Model 6 (MBQ) Improvement.

Queue Model 6, the historic maximum back of queue model (MBQ), has been modified to prevent the denominator from going zero or negative under grossly over-saturated conditions.

This enhancement prevents the model from delivering negative results or crashing under these conditions, and displays '*****' as the queue result.

>RESET OUTPUT fixed.

The RESET function was inadvertantly disabled for the OUTPUT Worksheets entry with the initial release of SIGNAL2000. This function has been enabled. This has no effect on the computation of results, but simply enables the ability to turn the Worksheet output off using the RESET function.

:SIGNAL2000 Ver 1.10 25SEP01

>TEAPAC2000 Interface Version 5 Implemented.

The WinTEAPAC2000 Version 5 interface has been implemented in SIGNAL2000 to provide the latest standardized TEAPAC interface found in all TEAPAC programs. The following lists the many changes which this new interface provides:

>New Tabular View Option Provides Dense Data Entry Displays.

Two views for Visual Mode, normal and tabular
More data inputs per dialog, less helps and cues
Toggle view between Normal and Tabular with View menu or F3 key
Tooltip help and status line help for each entry field
Context-sensitive help button for access to complete help in .HLP
Execute button for action functions
Next & Prev buttons if input list takes more than one dialog (PgUp & PgDn)
Alt-X accel to move through input keywords (commands) with keyboard
Create custom Tabular View input dialog with ASK command from Manual Mode
IODEV param #1 changed to toggle View
Options-Setup allows option to startup program in Tabular View

>New Recent File Dialog in File Menu.

Review list of last nine files and paths used
Can select/edit file names and re-open selected files
Option to include list of recent files and paths in File menu
List of recent files can be cleared from the dialog

>New Features for Saving Files.

Files now contain name & version of program which wrote the file
also include the date & time of the Save

easily viewable information at the beginning of the file
Message advising of successful save remains visible until closed by user
option to close the message automatically for subsequent Saves
Warning if Save is attempted into a file that may over-write other info
warning condition is if file was written by another program or unknown
certain earlier versions of the same prog may provide warning if relevant
option to cancel save or to permit save anyway

>New Feature for Opening Files.

If data from another prog or earlier ver of same program read from a file,
that file is protected from Saves that may over-write other information
In particular, for file from another program, Share is automatic, makes
File-Open same as File-OpenShared & LOAD * * * same as LOAD * * Share
eliminates the need to use the OpenShared or LOAD * * Share explicitly

>New Results Log Option.

Ability to create text file with results of primary functions of program
Log Results item in Options menu
Log On/Off toggles whether computed results are currently being logged
Start New Log clears all prior logged results and toggles Log On
Log file is always the program name with .log extension
located in folder where program was installed

>Improvements Regarding Output Titling Information.

Any time a title line is read from a file, displayed in the title bar
provides feedback when loading multiple stacked files or control file
Blank title entries are saved in such a way that they will be restored
previously, blank entries were ignored, leaving the prior entry
The option to use %F in a title line entry is noted in the input dialog

>TED Edit Window Available in Advanced Edit Option of File Menu.

Option to edit current open file (#1) contents directly,
particularly for control files
also option to open a different file into the editor
converts to TEAPAC format when Saved
CONVERT.exe no longer needed for small files
available only when licensed copy of TED is installed
Upon saving the edits, option to open the edited file into the program
e.g., to Launch an edited control file

>Printer Setup Supported Directly in File Menu.

Option to Setup printer only, or Setup and Print
  ability to select printer and printer options while in the program
  prior method only allowed printing to current selected printer and option
Toolbar button and Ctrl-P accelerator print immediately with current setup
Same print options are provided in the File menu of the Output window

>Improved Context-Sensitive Help Features.

Tooltip popup help has been added for any dialog box input field or button
  display after delay when mouse cursor hovers over input field or button
Status line help also appears for the input field with the input cursor
HELP in manual mode for a single command displays the relevant part of .HLP
As before, Help button or F1 key to display the relevant part of .HLP

>New Save and Linkage Features Provided When Exiting the Program.

Warning message for unsaved data has been reversed with option to Save
  message now consistent with most other Windows programs
    (in the way the question is asked)
  option to Save or not save, or to Cancel the exit
New ability to link to another program using the File-Control-Stop dialog
  name the next program to run, as well as file to use, if desired
  can be used from a control file to link programs or control files
  also link from Manual Mode
The Quit menu which duplicated the File-Exit menu has been removed

>Command History in Manual Mode.

Remembers last 10 manual mode commands used
Use up- and down-arrows to see history of commands
Re-use previous command or adjust to create new command

>WinTEAPAC2000 Ver 5 Menu Program Enhanced.

A data file can be named in the display for the next selected program
A Browse button has been added to assist in naming the data file to be used
  provides standard extensions for typical files of supported programs
A data file from a TEAPAC2000 Version 5 program can be dragged to WinTEAPAC
  will launch the program that created the file and use the dragged file
  can drag the file to the WinTEAPAC window or desktop icon
The .FOR extension used by TEAPAC is registered when WinTEAPAC runs
  allows double-clicking .FOR files in Explorer and START command in .BAT

>Other Changes:

A 'Getting Started' help button is now available in the main window
The option to Save output to a text file now allows the user to name a file
A more informative message is issued if a file to open is already in use
Better message if attempt to Open a non-TEAPAC file
TEAPAC programs can now be installed in a folder with spaces in path name
A new option exists to automatically close subsequent warnings and errors
  stays in effect until control returned to user
  for stacked files and control files
Files can now be dragged to a desktop icon to launch the program
  uses the dragged file
All keywords now display using title-case instead of all-caps
All dialog boxes have been enhanced with a more modern look
  using depressed input fields
Protect the Options-Setup fields which should not be changed
  except by re-installing
Browse buttons have been added for the data and host path entries
  to simplify changes
The current data file path from Options-Setup is shown in the FILES dialog
Reading data from a file during control file execution doesn't set flag so
  won't get prompted with message to save data from a control file
Better closure of main window if control file halts program
  same function improved if control file dragged to main window halts prog
Hourglass mouse cursor displays while printing

:SIGNAL2000 Ver 1.01 22FEB01

>New Constraints for Queue Model Calculations.

The HCM Capacity Committee has discovered that in the transcription of the underlying research which led to the new queue model in the HCM2000, the HCM2000 contractor omitted a number of critical constraints which must be applied when making the computations of that model. Not using these constraints has led to irrational results in some cases, including extremely large queue values, negatvie queues, and even program crashes. Although these problems could have been observed under many different circumstances, they occurred predominantly when arrival types other than 3 were used and/or when conditions were oversaturated. An addenda in the form of an official interpretaion from the Capacity Committee will formally amend these missing constraints to the HCM. SIGNAL2000 now uses these new constraints and produces much more sensible results under these conditions.

The underlying theory which leads to these constraints for the HCM queue model also apply to the calculation of delay, so the same constraints will be imposed by the Committee on the HCM

delay equations. In this case, however, they are much less likely to cause any change in results due to other limits which are already present in the delay methodology of the HCM2000.

Also, several of the other queue models supported by SIGNAL2000 via the QueueCalcs function had the ability to generate very large results which might overflow the computation and/or display limits of the program, resulting in a crash. These results have been trapped and are displayed with asterisks '*****' so that computations may continue without a crash. Specifically, Models 7 & 8 can produce conditions which exceed the computational limits of typical PCs for the Poisson distribution for high percentiles and/or high v/c ratios. Under very high oversaturation, all of the models may produce queue lengths (in feet) which exceed the display space available. All of these cases now produce '*****' to avoid the program crash.

>New Direct EXPORT for HCS2000.

Now that the HCS2000 program has been released, SIGNAL2000 supports a direct EXPORT to HCS2000, including all of the new input variables which were not previously included in the HCS-3 EXPORT previously supported by SIGNAL2000. These new variables include bicycle volumes, queue storage space and lengths of queued vehicles. Previous EXPORTs from SIGNAL2000 would not have included these variables. SIGNAL2000 and WinTEAPAC also support running the executable Signals module of HCS2000. The default installation location of HCS2000 is now the default for the new WinTEAPAC and SIGNAL2000 EXPORT configuration. The new EXPORT feature will make it easy to run comparable analyses with both SIGNAL2000 and HCS2000. Check the HCS Watch page at www.StrongConcepts.com for a record of problem reports in HCS2000 that this capability uncovers.

>Enhanced Shared-Exclusive Lane Modeling (Dual-Optional Lanes).

A number of important enhancements in the way shared-exclusive lanes are modelled in SIGNAL2000 have been made which will deliver better results over a wider range of conditions. These lane configurations are those which contain both exclusive turn lanes and shared-lanes for a given turn maneuver, and are called Dual-Optional lanes in SIGNAL2000. Dual-Optional lanes are implemented in SIGNAL2000 using the GROUPTYPES entry. These changes include the following:

The dual-optional model has been extended to include exclusive lane turn movements which also share lanes with other exclusive lane turn movements. It has also been extended to include through lanes which share lanes with both adjacent exclusive lane turn movements. Previously, turns with exclusive lanes could only share lanes with the adjacent through movement (not another turn movement), and a given through movement could shared lanes with only one of the turns on the approach which also had exclusive turn lanes. As before, the computation of the lane assignment of optional turns in the shared lane is automatic, but a new limit has been imposed on this calculation which prevents an inordinate number of vehicles to be re-assigned to the shared lane group. Effectively, this limit allows the shared lane to only receive a maximum total flow as defined by the input value of the lane utilization factor for the shared lane group.

Assigning more than this amount would effectively move vehicles into a second shared lane, which would be impossible.

In light of the above change, the percentage of turning traffic in a dual-optional through lane group is now re-computed for all turns in the lane group after the shared-lane volume has been determined to reflect the adjustment in the total volume in the lane group. The percent trucks in the lane groups with dual-optional turns included is also re-computed to reflect the potential difference in truck percentages from each of the contributing movements in the shared lane.

Exporting of dual-optional lanes to HCS2000 is now supported directly for all of the models described above, without the need for any additional user adjustment (as was previously required). This includes the proper setting of the number of lanes, the shared-lane status, and the percent turns using the shared lane input value.

Dual-optional lane groups are now labelled in the SIGNAL2000 outputs in a more clear way by showing the movement labels for the movements which have been included in the shared lane groups. The + and - signs used previously next to dual-optional lane widths are still included to indicate the presence of additional or less capacity due to the dual-optional status.

>Better Input Error Detection for Special Phasing Definition.

Additional error detection has been added to user input of special phasings (e.g., using PHASEMOVS with SEQUENCE 0) to improve the likelihood of detecting improper phasing definitions. In particular, the use of negative movement numbers to represent permitted left turn phasing has been augmented by preventing the inadvertant use of negative numbers for through and right turn movements.

>Modeling for Special Case of Permitted Left Turn Corrected.

An obscure special case of the Single-Lane Approach permitted left turn model has been implemented, whereby if the opposing single-lane approach has a left turn volume of zero the calculated value of 'gdiff' is set to zero. Although occurence of this case is rare, when it does occur this new model will produce a different and more reasonble result, according to the methods of the HCM.

>Improved Modeling of MOE's in EVALUATE for Protected-Permitted Left Turns.

The HCM2000 queue model specifies a special averaging method to determine a single value of satflow for protected-permitted left turns for use in various traffic calculations such a v/s. For consistency, this technique has been extended into the other MOE calculations in the EVALUATE report along with the total g/C for the combined phases. This technique is arguably a superior way to estimate the effect of combined protected-permitted phasing on MOE calculations such as fuel consumption, CO emissions, vehicles stops, etc.

:SIGNAL2000 Ver 1.00 12OCT00

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>Queue Model Adjustment for Grossly Oversaturated Conditions.

Queue models 7 and 8 cannot be evaluated for grossly oversaturated conditions without exceeding the computational limits of most PC's. These queue models have been modified to provide an estimate of the desired queue value in order to avoid a possible crash when these conditions are encountered.

Build 00 07DEC00

>SIGNAL2000 Hits the Street.

SIGNAL2000 is the first piece of software available which implements the procedures of Chapter 16 of the 2000 Highway Capacity Manual (HCM), released concurrently with the publication of the 2000 HCM by the Transportation Research Board. Over two years in the making and based on its popular predecessors, SIGNAL97/SIGNAL94/SIGNAL85, SIGNAL2000 goes one major step further than the procedures of Chapter 16 -- SIGNAL2000 also optimizes the phasings and timings of an intersection to produce the best possible capacity analysis, like SIGNAL97 has done previously.

>New Features Offered by SIGNAL2000.

SIGNAL2000 offers many new features above and beyond those available in SIGNAL97. These features are discussed in the following paragraphs.

>New 2000 HCM Methods Implemented.

The basic methodology of the 2000 HCM for signalized intersections has been implemented in the SIGNAL2000 program. The changes over the 1997 HCM method consist primarily of the addition of the new queue model offered by the HCM, the new detailed modeling of pedestrian and bicycle interference on vehicular traffic, a new model for shared-lane, protected-permitted left turns, and completely revised and detailed worksheet formats. Of particular interest, the new HCM queue model in Appendix G of the 2000 HCM takes into account the effects that all of the following conditions have on queueing: volume of demand, actual green time, cycle length, saturation flow, capacity, v/c, maximum extent of queue on pavement, coordinated operation, actuated operation, unbalanced lane utilization, protected-permitted operation, over-saturation, upstream v/c, initial queues, length of analysis period, average storage length of queued vehicles and various percentile estimates; thus it is the most comprehensive and legitimate queue model available for the widest possible range of conditions.

>New QUEUECALCS & QUEUEMODELS Functions.

A new QUEUECALCS function has been provided which provides unprecedented flexibility in calculating and comparing queue values using the many different queue models which have been in use over the years, as well as the new 2000 HCM queue model described above. QUEUECALCS allows the side-by-side comparison of the results of 10 different queue model calculations for a given capacity analysis condition, with any one of these models being selectable as the model of choice in the capacity analysis output. Four basic model structures are included: the 2000 HCM model, the ARRB model, the MBQ model, and the SIGNAL97 model. Several variations of these models are computed bringing the number of models calculated to ten. The basis of the variatiions revolve around whether the calculation is for the average lane of a lane group or for the worst lane of a lane group, whether the average or percentile queue value is calculated, and whether constant or user-input vehicle spacings are used. The following summarizes the characteristics of each of the ten models used.

1 - HCM 2000 HCM, MBQ, Worst Lane. XXth Percentile Queue
2 - HCM 2000 HCM, MBQ, Average Lane, XXth Percentile Queue
3 - ARRB ARRB, MBQ, Worst Lane, 95th Percentile Queue
4 - HCM 2000 HCM, MBQ, Worst Lane, Average Queue
5 - HCM 2000 HCM, MBQ, Average Lane, Average Queue
6 - MBQ Historical MBQ, Average Lane, Average Queue
7 - S97E+ SIGNAL97 Evaluate+, MQL, Average Lane, XXth Percentile Queue
8 - S97A+ SIGNAL97 Analyze+, MQL, Average Lane, XXth Percentile Queue
9 - S97E SIGNAL97 Evaluate, MQL, Average Lane, 90th Percentile Queue
10 - S97A SIGNAL97 Analyze, MQL, Average Lane, 90th Percentile Queue

Appendix C of the manual (both printed and online as the Help file) provides complete detail of each of the models. The QUEUEMODELS inputs have been enabled in order to define the characteristics of each of these models, and the STORAGE input has also been enabled in support of the queue ratio calculations.

>Initial Queue Delays Calculated.

Delay which results from standing queues at the beginning of the analysis period are now calculated according to the procedures defined in Appendix F of the 2000 HCM. These queues can have an important impact on the delay calculated for a peak period, and even on the selection of the design period for an analysis. The INITIALQUEUE input has been enabled in support of these calculations.

>HCM Delay Displayed in EVAULATE Results.

The delay reported in the results of the EVALUATE function now reports the same delay as calculated by the HCM methodology. Previously an alternative delay formulation was used in contrast to the HCM method, specifically to address the limitations of the HCM method for calculating over-saturated delay, but this differentiation is no longer needed since the HCM delay method is now completely robust in this regard.

>More Flexibility in Worksheet Display.

The 2000 HCM contains a myriad of worksheets which detail the HCM calculation methodology. In order to help sort through these worksheets for the essential results, a new OUTPUT option has been added to produce only the BASIC worksheets -- these are the Input Worksheet, the Volume and Satflow Worksheet, and the Capacity and LOS Worksheet. The OUTPUT options are now: NONE/BASIC/FULL.

>SIGNAL97 Build 16 Changes.

Several minor changes have been made to SIGNAL97 in its final release (Build 16) which also appear in the new SIGNAL2000 program. These include an improved method for determining the lost time for shared lane groups on the stem of a T intersection and improved exporting of actuated and pedestrian conditions to HCS. See SIGNAL97 release notes (SIGNAL97.MSG) for more detail on these items.

>Improved HCS Export.

In addition to the improved HCS export discussed above, SIGNAL2000 also checks the ranges of data being exported to HCS, since HCS has certain input limitations that are more limiting than SIGNAL2000, and HCS reacts poorly to exported data which exceeds these limits.

>Phasing Inputs Checked for Validity.

Certain phasings which appear to be valid are in fact not allowed by the HCM methodology, so SIGNAL2000 provides an additional cross-check to confirm that these phasings have not been used when they are not appropriate. Specifically, if a left turn is made from a shared lane, the HCM method does not support the calculation of delay for that left turn if the phasing does not allow the associated through movement to move during all phases where the left turn is allowed to move. This means that SEQUENCE codes 4/5/6 are not allowed under these conditions, although this may not be immediately apparent upon casual inspection of the HCM. SIGNAL2000 verifies that this condition does not exist (SIGNAL97 only checked that it was not allowed for the DESIGN function). Also, the HCM does not support the calculation of delay for movements which start and stop more than once during the cycle, since this violates the basic premise of Webster's original delay formulation. The most common occurence of this situation is with right turn arrows. SIGNAL2000 now checks for this condition as well when the PHASEMOVEMENTS entry is used to define a phasing for analysis. Lastly, SIGNHAL2000 checks to make sure that protected-permitted phasings have been entered properly when entered using the PHASEMOVEMENTS method.

>GROUPTYPES Entry Re-located Closer to WIDTHS and LANES.

The position of the GROUPTYPES entry has been re-located in the Edit-Movement menu so that it directly follows the entry of WIDTHS and LANES. Now users will be able to input certain special lane use conditions like dual-optional turn lanes and free-flow lanes immediately after entering the basic lane group width information.

>SUMMARIZE Includes New Input Variables.

The SUMMARIZE display (also produced by the View-Summary menu option) has been updated to include the new user inputs such as INITIALQUEUE, STORAGE, QUEUEMODELS and BIKEVOLUMES.

>Version Information Saved in Data Files.

The first line of a SAVEd data file now contains information regarding the name and version of the program producing the file (SIGNAL2000 in this case), as well as the date and time the Save was performed. This information may be helpful to users sorting through data files at a later date. It is also anticipated that future versions of TEAPAC programs may be able to make use of this data, as well.

INDEX

This index provides an alphabetical list of keywords, commands and subjects covered in the *SIGNAL2000 Tutorial/Reference Manual*. This includes references made in both the Tutorial and Reference sections of the manual. Tutorial Manual references are indicated by page numbers alone, while Reference Manual locations are indicated by the Appendix letter preceding the page number of that appendix.

Entries in the index which are in all capital letters usually refer to specific commands of the program. They may also refer to keyword options or a program name. Entries in all capital letters enclosed in square brackets [XXX] refer to group/menu names representing specific menus or groups of commands. Entries enclosed in angle brackets <XXX> refer to specific data inputs associated with commands of the program. Entries preceded by an equal sign =XXX indicate a discussion of an output of the program, either a result of the computations or an input tabulation.

The primary discussions for commands are indicated by page locations in **bold print**, located in Appendix B of the Reference Manual.

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A

B

C

D

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F

G

H

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K

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M

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V

W

Y

Z